PMI

VOL. 3 NO. 13
DECEMBER
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PHOTO METHODS FOR INDUSTRY

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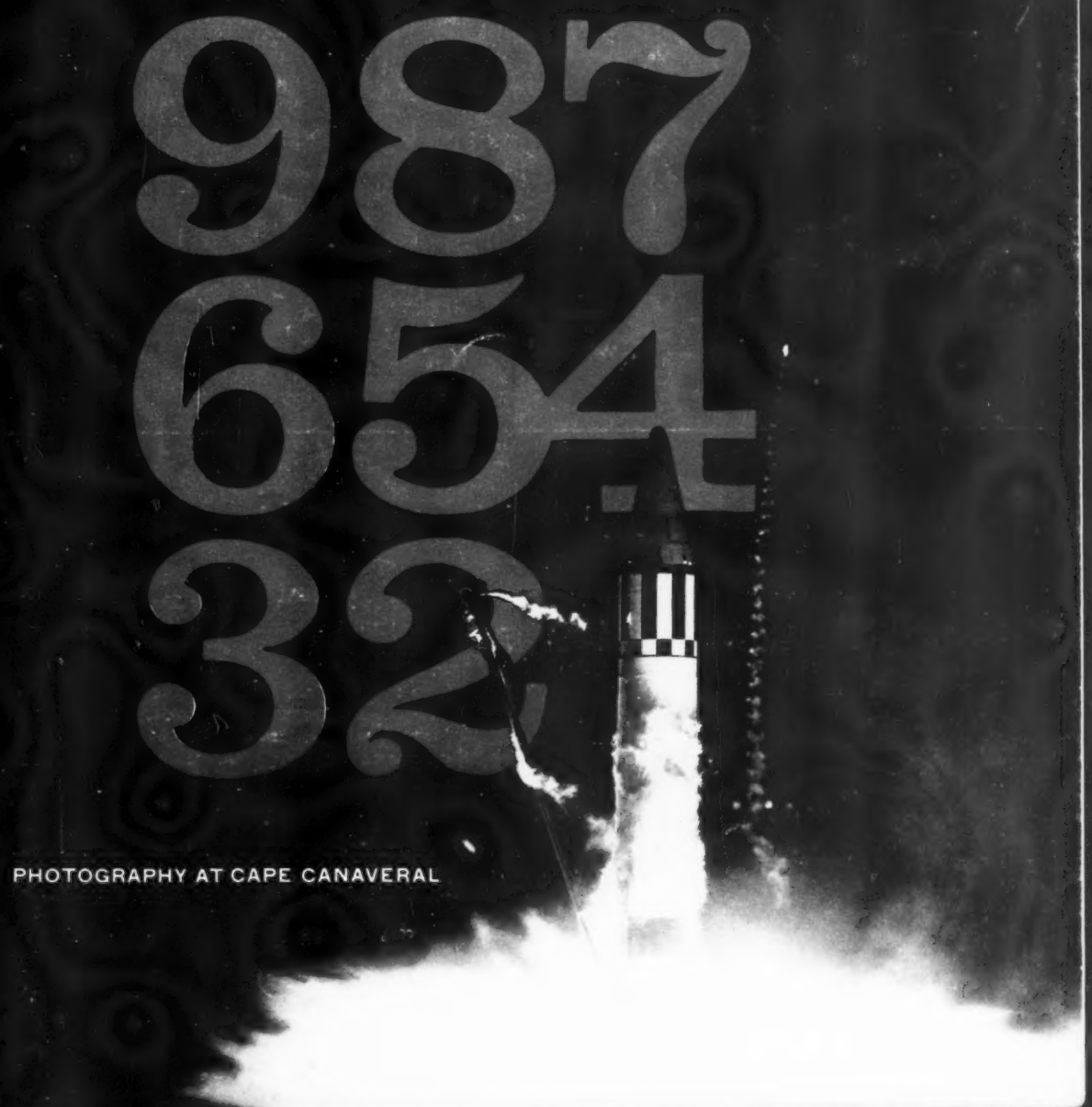

PHOTOGRAPHY AT CAPE CANAVERAL

A Bargain at 489^{50}

You don't ordinarily think of a $489.50 camera in terms of a 'bargain'. Yet, when you consider that 'bargain' is another way of saying 'value', another way of expressing how much you're getting for your money, the idea of a Bronica as a 'bargain' begins to make real sense.

One way to determine what and how much the Bronica offers is to examine its features. Comparison will tell you how much more it offers than other cameras. And a personal, in-hand demonstration, at your dealer, will then show you what these features mean in terms of quality and performance.

The Bronica is the only fully automatic, 2¼-square, single-lens reflex in the field. And here are its features:
• instant-return automatic mirror • instant-reopen automatic diaphragm • depth-of-field preview button • interchangeable Auto-Nikkor lenses, standard equipment • 75mm normal lens focuses to 19 inches • accepts 50mm wide-angle lens • focal plane shutter has speeds from 10 seconds to 1/1250th • continuously variable delayed action from 1 to 10 seconds • interchangeable FILMINDER back—*remembers* whether film has been advanced and whether or not shutter has been wound • FILMINDER back cannot be removed unless dark-slide is fully inserted • dark slide cannot be withdrawn from back while off camera • automatic tension device keeps film taut and flat for exposure—relaxes when film is advanced • auto-reset exposure counter • interchangeable focusing hood • optional equipment: lenses to 1000mm, eyelevel prism finder, FILMINDER backs, extension tubes, filters, lens hoods, cases, etc.

Now visit your Bronica dealer for a personal in-hand demonstration. Bronica with 75mm Auto-Nikkor f2.8 lens, $489.50. For complete details, write to Dept. PM-12.

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Get more information. Circle 417, page 77

Miniaturization Report No.2

Micro-Master® 105/35mm as a dynamic in-plant tool

Today, the miniaturization system which does no more than microfilm engineering drawings has won but half the battle. The other half consists of rendering versatile service as a drafting and reproduction tool. Only in this way does the equipment become a money-maker instead of a capital expense. MICRO-MASTER 105/35mm by K&E is the system that saves money, speeds production, greatly expands the capabilities of an engineering reproduction department. True, MICRO-MASTER *does* reduce drawings to miniature negatives and project them back to full or half size. But it goes beyond this to perform a host of other functions – some of which we will outline here.

REDUCED SIZE PRINTS. The growing use of "half-size" working prints is saving industrial reproduction departments a fortune in material costs. This is how the system can work: reduce originals on either 105mm or 35mm negatives. Make blow-backs on transparent material to one-half the linear scale of the original – which actually is one-fourth the area. Diazo or blueprint paper consumption will be reduced by *three-fourths!* Of course, the photo-image must be impeccable, never losing a detail. Projection prints must be pin-point sharp, clearly readable. The burden is on the camera-projector, and only MICRO-MASTER can deliver the quality and range needed by most companies. A 35mm unit alone won't handle larger drawings because of the great reduction necessary to put them on a negative less than two inches square. Only 105/35mm used in conjunction deliver a complete half-size program.

SCISSOR DRAFTING. Drafting departments are often requested to retain elements of a drawing, and add new details. Or they may be asked to combine portions of different originals. Rather than re-trace or start from scratch, modern practice is to scissor out the needed elements, place them on a new title sheet, make additions, and photograph the resulting composite. MICRO-MASTER serves as a vital tool for this time-saving, cost-saving technique. Second-originals are made from 105mm or 35mm negatives. The elements are cut out and pasted down with transparent tape. New details are entered, and the entire drawing filmed and projected for a final, ink-like original – comparable in every way to the most meticulous hand work. Even if the elements abstracted are to different scales, they can be brought to a common scale easily and quickly with the MICRO-MASTER Camera-Projector. A drawing that would take 20-30 hours of a draftsman's time can be produced photographically in less than an hour!

OTHER DRAFTING TECHNIQUES. In printed circuitry, layouts done several times up can be reduced and printed on stable-based materials to microscopic accuracy. Plant layout work can be done with no drafting at all – simply by placing various pre-printed components on a master sheet. Tone-coded prints in which old work is distinguished from new by a light half-tone screen, can be produced in the projection stage.

RESTORATION. MICRO-MASTER offers exclusively controlled front and back lighting to build up contrast in badly soiled drawings. A vacuum easel holds drawings perfectly flat for the camera. Result: high-contrast, superb-quality negatives and prints – up to 42" x 63". Users have found that close to 90% of their aged tracings can be restored like new, practically eliminating costly hand re-tracing.

DISCARDING OF ORIGINALS. Since MICRO-MASTER produces projection prints of a *least* equal quality to the original itself, all originals can be discarded. On one case, 200,000 originals were replaced with 200,000 MICRO-MASTER negatives, reducing storage area from 1,400 to only 30 square feet!

To repeat: a miniaturization unit falls short if all it can do is record images. Far more can be, and should be, expected of it. For the unit that does the most jobs, and does them to the highest quality, the choice is MICRO-MASTER. We'll be pleased to give you further information – facts, figures, case-histories. Simply return the coupon below.

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☐ Please have a K&E representative call.

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1546

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LEICA dependable tool for industry

THE BODY of the LEICA is housed in a rigid, one-piece casting that assures constant, precise alignment between lens and focal plane despite hard daily use.

VERSATILITY AND COMPLETENESS of the LEICA SYSTEM make it easy to capture arresting pictures on location without interrupting production. Instructional photograph of tiny ball bearing was made with Leica, Visoflex, Bellows, 135mm lens.

THE LENSES for the LEICA M-3 give you complete control over perspective and image size; your pictures tell the story just as you want them to. Choose from 11 interchangeable lenses from 21mm to 400mm in focal length.

THE VIEWFINDER of the Leica automatically shows the field of each lens from 35mm to 135mm with no confusing "pile-up" of bright-line frames. Parallax compensation is automatic, too. What you see, you get on film.

You must have a camera you can depend on, because your job is to make pictures—not excuses. That's why so many industrial photographers have turned to the rugged, versatile LEICA M-3 to bring back the pictures no matter how difficult the working conditions. They also depend on Leica accessories as precise as the camera itself to adapt the M-3 to any plant assignment—including the unprecedented one that may develop tomorrow! For the future is designed right into the Leica System of photography. Call on a franchised LEICA dealer soon. See the M-3. See why they say that good things come in small packages!

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COMING UP

JANUARY 12-15 Mid-Winter conference of NAVA. Statler Hilton, Dallas, Texas.

JANUARY 16-17 Fourth Annual New England Industrial Photographic Trade Show. Motel 128, Dedham, Massachusetts.

FEBRUARY 16 Eastern Regional Photo Instrumentation Round Table & Clinic. Hotel Statler-Hilton, N. Y. Contact Arthur Dorman, Walnut 1-2345, Syosset, L. I.

APRIL 4-6 National Microfilm Association Convention, Hotel Sherman, Chicago, Ill.

MONTHLY MEETINGS

Association of Federal Photographers Meetings every third Wednesday at 8 p.m. G.S.A. Building, 7th and D Sts., S.W., Washington, D. C.

Cleveland Chapter SPSE Meetings the first Tuesday of each month. Cleveland Engineering & Scientific Center, 3100 Chester Ave., Cleveland, Ohio. Contact Robert E. Birr, General Electric, Nela Park, Cleveland, Ohio. GL 1-6600.

Rochester Chapter SPSE First Monday. Contact Woodlief Thomas, Jr. Color Technology Division, Building 65, Kodak Park, Rochester 4, N. Y. CO 6-2500.

Industrial Photographers of America Essex House, Newark, N. J. Meetings every second and fourth Thursday. Contact Tom Holbarton, 181 Lake Drive West, Packanack Lake, Wayne, N. J. Or R. Handley, The Port of New York Authority, 111 8th Ave., New York 11.

National Visual Presentation Association, Inc. New York City. Meetings every second Thursday. Contact M. E. Schack, 19 W. 44th Street, N. Y., N. Y. MU 2-2294.

New York Chapter SPIE Meetings every third Thursday. Contact Don Bass, P.O. Box 177, Bethpage, L. I., N. Y. Liggett 4-8196.

New York City Chapter SMPTE Meetings first or second Wednesday of each month. Contact Ed Warnecke, Eastman Kodak Co., 342 Madison Ave., New York, N. Y. MU 7-7080.

Boston Chapter SPSE Contact John Taylor, Itek Corp., 700 Commonwealth Ave., Boston, Mass., CO 7-5210.

Binghamton Chapter SPSE Meetings every third Tuesday. Contact H. G. Morse, Ansco, Binghamton, N. Y. RA 2-4221, Ext. 573.

Midwest Industrial Photographers' Association Contact John E. Schrage, c/o Deere & Co., Photo Department, 3300 River Drive, Moline, Ill.

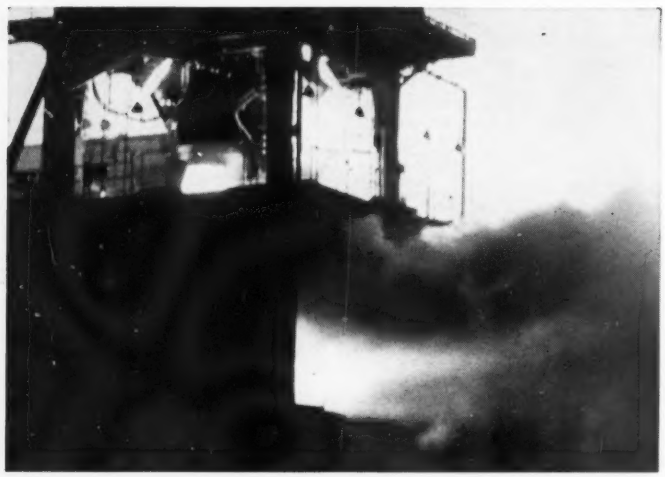
Rocky Mountain Industrial Photographers Meetings every fourth Monday. Contact P. H. Broadie, 2170 S. Lincoln, Denver 10, Colo. Telephone PEarl 3-2200.

Southern California Chapter SPSE Meetings the last Monday of each month. Contact Ben Augustine, 235 Annandale Rd., Pasadena 2, Calif. Telephone MU 1-0076.

Southern California Chapter Industrial Photographers Meetings every third Tuesday. Contact Janet Marshall, Executive Secretary, 5463 Virginia Ave., Los Angeles 29, Calif. HO 5-6614.

If you wish to have your meeting dates listed in this column send in the necessary information to COMING UP, PMI, 33 W. 60th St., New York 23, N. Y.

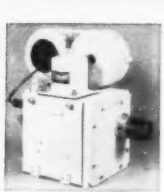
AUTEX* catches the flame



A film sequence of a rocket engine test properly exposed from countdown to flame-out dramatically demonstrates the AUTEX Automatic Exposure Control as a new and versatile tool for the photoinstrumentation engineer. Coupled to any lens this photosensitive servomechanism corrects for light changes as fast as 7 stops per second to record the unexpected along with the normal.

Used on airborne cameras, unattended time lapse cameras, and surveillance cameras, the AUTEX adds a new flexibility to the growing usefulness of photoinstrumentation.

The new Model VI-4 AUTEX is a typical product of the combined photographic and electronic instrumentation abilities of Flight Research. For detailed information concerning the AUTEX and Flight Research's complete line of photoinstrumentation equipment, write to:



The Model V-A MULTIDATA® CAMERA—For 70 MM Instrumentation of Rockets, Missiles, Sled Ejections, Re-entry. Superbly suited because of these capabilities . . . 2¼" x 2¼" frames . . . up to 60 fps standard . . . automatic shutter synchronization . . . vacuum back for highest resolution . . . double pin registration . . . 60 cycle, 400 cycle or DC motors . . . time and coding lamps . . . lighted fiducial markers . . . precision mounting pads . . . and all important . . . PROVEN RELIABILITY. From $9000.

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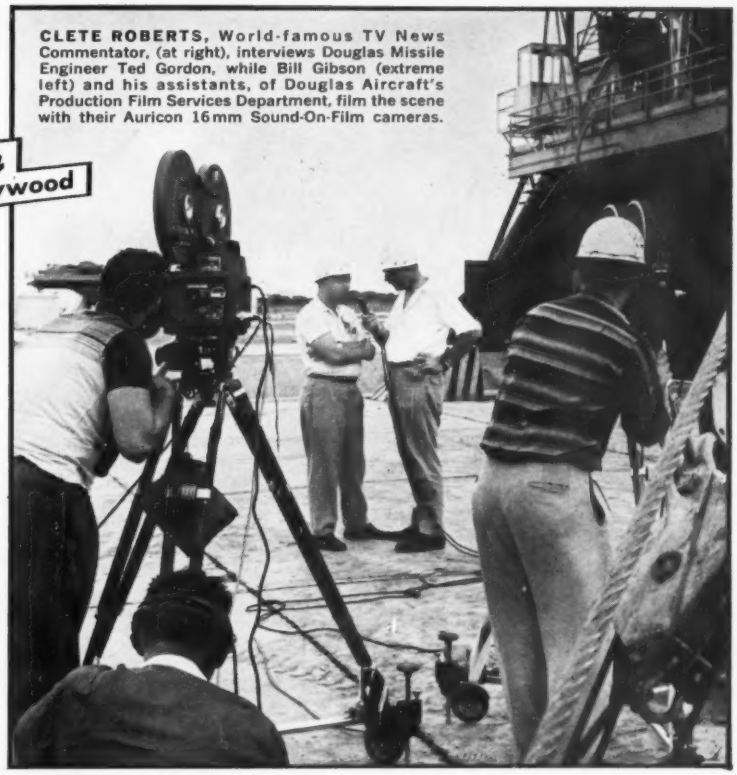
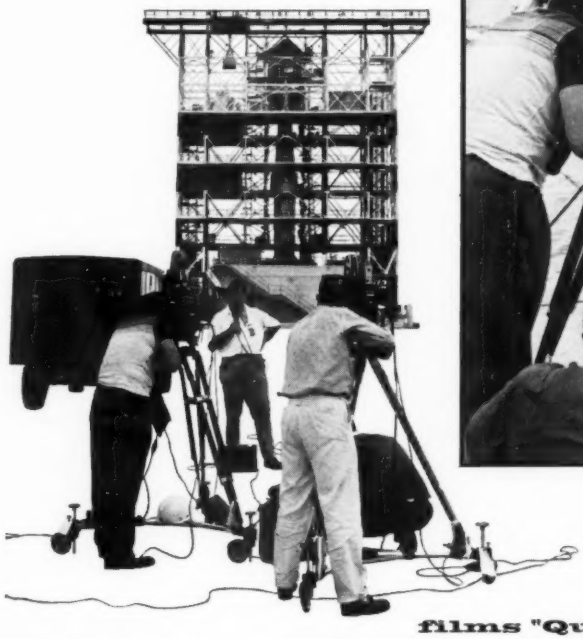
DOUGLAS

Auricon Hollywood



CLETE ROBERTS, World-famous TV News Commentator, (at right), interviews Douglas Missile Engineer Ted Gordon, while Bill Gibson (extreme left) and his assistants, of Douglas Aircraft's Production Film Services Department, film the scene with their Auricon 16mm Sound-On-Film cameras.



DOUGLAS films "Quick-Look" Progress Reports

...with AURICON 16mm Sound-On-Film RELIABILITY!

AURICON SUPER-1200 SOUND-CAMERA FEATURES:

- ★ Full-Frame Ground Glass Focusing Optical System. No camera weight shift when moving from focus to film shooting position.
- ★ Jewel-hard Sapphire Film Gate for frictionless operation and scratch-free pictures.
- ★ Auricon is the Quiet One — no "blimping" is required.
- ★ 1200 ft. film capacity for 33 minutes of continuous recording.
- ★ Optional Optical or Filmagnetic Sound-On-Film.
- ★ ... and many other features!

During the critical count-down and through the thunderous and fiery launchings of the Air Force Thor Missile at Cape Canaveral, every detail of these space technology achievements is faithfully recorded with sound and color film. Auricon 16mm Cameras, operate by remote control within 200 feet of the searing blast of the rocket engines!

The reliability of Auricon Sound Cameras is a vital factor in providing Air Force officials and Douglas Top Management with "Quick-Look" Progress Reports of the very successful missile firings of the Thor IRBM. In less than 72 hours from "zero-time" at Cape Canaveral, Florida, the Filmed Progress Report is flown to California, processed, edited, titled, and made available for viewing and technical evaluation. Auricon missile-launching sound films are produced for as little as $200 per film ... a tiny price for fast, comprehensive, and truly graphic reporting!

Auricon 16mm "Talking Pictures" may be ideal in your business, for technical reporting and sales promotion. Write us about your motion picture sound recording requirements.

THE Auricon Hollywood LINE OF

16MM SOUND-ON-FILM CAMERAS

CINE-VOICE II	AURICON PRO-600	AURICON SUPER-1200
100 ft. Runs 2¾ min.	600 ft. Runs 16½ min.	1200 ft. Runs 33 min.
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WHICH
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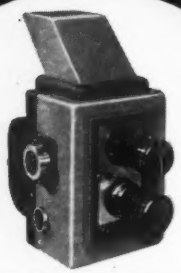
MODEL A PORTRONIC–70mm portrait camera. Automatic electric or manual operation.



IMPERIAL #90–Uses 3½" heavy-base roll film. Adaptable to 70mm. The ultimate in automatic portraiture.

Do you do mass school photography? Identification photos? Fine portraiture? These are some of the questions that determine which Beattie Portronic is best for your needs. Incomparable efficiency, complete automation, electric shutter, automatic film advance, negative identification, reflex viewer with matched lenses and removable magazines are available. All models are Beattie precision quality. Compare them at your Beattie dealer's now.

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Edward R. Farber

ELECTRONIC FLASH

Those smaller, brighter, lighter units; do they fit a pro's needs?

The Photokina turned up a profusion of small electronic flash units—and considerable confusion in customers' minds as well. Smaller, brighter, lighter and mightier spiel the promotion pieces to puzzled purchasers. And it's true. The units are tiny and bright. But how to choose?

As the circuits become more complicated and the claims conflicting, the purchaser has little chance to evaluate equipment—even through the eyes of experts. By the time the design has been tried by time and proven with pictures, the model is changed again. Best bet is to find a manufacturer with a reputation for a good product and an excellent service policy. (Check with everyone you can on the latter. Guarantees and salesmen's say-sos are not enough.) Then consider some of the following.

Masters and slaves

First question is how much light do you really need *at the camera*? This is where these units were meant to be used. If most of your work is within 10 ft. of the lens, and particularly if you use short focal length lenses on 35mm cameras, you are not going to fare too badly with even the smallest units on the market. Shooting close with the light at the camera, you want to work with a limited depth of field because you cannot expose both background and foreground properly.

Now if you are going to use a number of light sources, these small units can be clamped easily almost anywhere. If the units can be equipped for slave operation, they make an economical and convenient all-around lighting package for black-and-white shooting—and for color too, within limits.

In other words, an investment of $150 to $200 buys you a set of three competent units; and the lot weighs but 3 to 5 lbs. You have the advantage of lighting versatility and interchangeability of equipment. If one of the units breaks down or runs out of juice, you still have two to do the job.

Before you make such an investment, however, be sure to try the slave devices available. Some are cumbersome and much too insensitive. If the slave obtains its operating power from the flash unit itself (some use separate batteries) try the slave under extreme conditions; when its power source is near the last of its rated number of flashes, and just as the ready light goes on. Some slave units are notoriously reluctant to operate at all under such conditions. Make additional slave tests under high humidity and low temperature conditions—which are not uncommon in the life of an industrial photographer—and also in large rooms where there is little reflection. Use your typical lighting formulas for this last test. Nothing can be so disappointing as recalcitrant slaves.

Embarrassment of riches

Then there is the problem of battery types. You have your pick of the integral nickel-cadmium battery, the instantly-replaceable nickel-cadmium battery, the standard flashlight cells (with an option of rechargeable or long-life single-use cells), and the limited-life rechargeable barium battery. Each of these is found in small units giving from 40 to over 100 flashes per charge or per set. Their use is somewhat dictated by the size and design of the battery and the flash unit.

If you expect to use more than the rated number of flashes per day with built-in batteries, you have a problem, naturally. It just might be possible that buying several extra units might be the cheaper and more practical alternative to buying larger, heavier units with replaceable batteries or the capacity for a greater number of batteries. Obviously this approach is valid only to a

(*continued on page* 10)

Graflex® photography ends age-old argument

A. M. Wettach, agricultural photographer of Mount Pleasant, Iowa.

Super Speed Graphic® with Graflex 1000 Shutter makes possible excellent action stopping ability because of its high efficiency and extreme accuracy. All camera controls are man-sized and conveniently located for easy reading. Cocking action is easier and more convenient because the combination lens shade and filter holder affords an easy to grasp method of cocking the shutter. Shutter speeds can be selected either before or after cocking. The big negative format provides maximum brilliance and detail, allows a good working size for cropping control.

For years, farmers have argued over the question of which way a pig's tail curls. Now, Mr. A. M. Wettach, well known agricultural photographer, has pictorial proof that it curls right, left and just hangs straight down. Using one of his Graflex Cameras, he captured this "evidence" shot on one of his recent assignments.

A 100% Graflex® photographer, Mr. Wettach uses a Pacemaker 4 x 5 Speed Graphic®, a Graphic View and a Super D Graflex camera. The Speed Graphic is his mainstay because it is so handy and versatile. Mr. Wettach uses the Graphic View on a platform on top of his car. He finds its swings and tilts and its ability to use a 90mm wide angle lens *ideal* for architectural shots, building exteriors and use in cramped quarters.

"I'd sure hate to have to do without any one of my Graflex cameras," says Mr. Wettach.

For complete product and price information, see your Graflex dealer or write to Dept. PMI-120, Graflex, Inc., Rochester 3, N. Y.

GRAFLEX®

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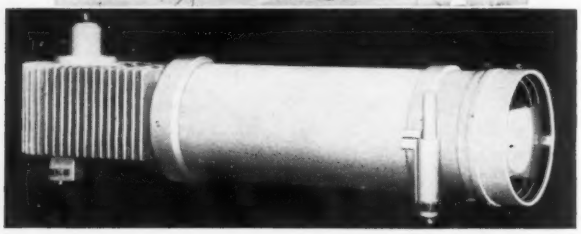
Get more information. Circle 440, page 77

ZOOMAR SERVICE COLLIMATOR

FOR CHECKING LONG RANGE LENSES AND CAMERAS IN THE FIELD



CHECKING LONG RANGE LENSES AND CAMERAS IN THE FIELD was not possible up to now because the right test equipment was missing. A check of infinity setting requires a distant target. This, even if readily available, is often made useless by air turbulence and poor weather conditions, just at a time when most needed.

THE ZOOMAR SERVICE COLLIMATOR, a portable instrument of appropriate design and resistance to environmental changes, meets the requirements of field use and makes the operator independent of weather conditions. It allows last minute tests **in the field** with a minimum of effort and a maximum of reliability.

FEATURES AND SPECIFICATIONS:

- "Thermax" mounted apochromatic catadioptric system of 150" E.F.
- Standard U.S. Air Force target (other targets optional)
- **Resolution:** 300 lines per mm, therefore, usable on lenses even longer than 200"
- Micro-adjustable legs for easy set-up.
- Suitable for selective part coverage for testing lenses of very large diameters
- **Height:** 10"; **Width:** 6½" **Length:** 30"; **Weight:** 25 lbs.

For prices and descriptive literature contact Dept:PMI-12-60

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Get more information. Circle 496, page 77.

ELECTRONIC FLASH

(*continued from page* 8)

point. If you buy a big unit with more than enough power, you'll be rewarded with shorter recycle times, other things being equal.

If you intend buying a unit with replaceable batteries and expect to use nickel-cadmium rechargeable cells, be sure to price the cells before you buy the unit. You may be shocked by the charge. Nickel-cad cells are not cheap. If you plan to use them in a unit designed for flashlight cells, you may need a separate charger too. All must be considered carefully in cost comparisons.

One annoying feature of some of the smaller flash units is the permanently-attached shutter cord. It is too fragile, too short, and it usually requires adapters to make it fit *your* camera. Furthermore it makes off-the-camera shooting difficult, the connection of a number of units to a common trip cord almost an impossibility because of the special connectors required. A notable exception is the new Heiland Futuramic II. It has a clever feature to minimize connector complications. The outlet has three slots to permit inserting the polarized plug facing left or right, thus minimizing sharp flexing of the trip cord whether the camera is at the port or the starboard.

By all means try the unit on the camera you intend to use, and determine first hand to what extent the cords and the unit interfere with the controls or the balance of the camera. Monopacks may leave the top of the camera free, but all too frequently they require brackets that must be removed before a film can be changed. From this point of view, the new separate lamp head types such as the Braun Hobby F60 and F30 have undeniable advantages with their impressively small lamp heads and impressive uniformity of illumination.

The shoe-mounted heads may however interfere with some camera controls, the use of special range-finders, exposure meters, etc. On the other hand, the more conventional bracket-mounted units may be a nuisance when rapid changing of film is essential.

Technically-minded photographers should ask for tables, charts, or graphs that indicate voltage regulation, recycle time, flashes per charge. There is no reason why manufacturers should not substantiate claims with engineering evidence. It will come when photographers request it.—THE END

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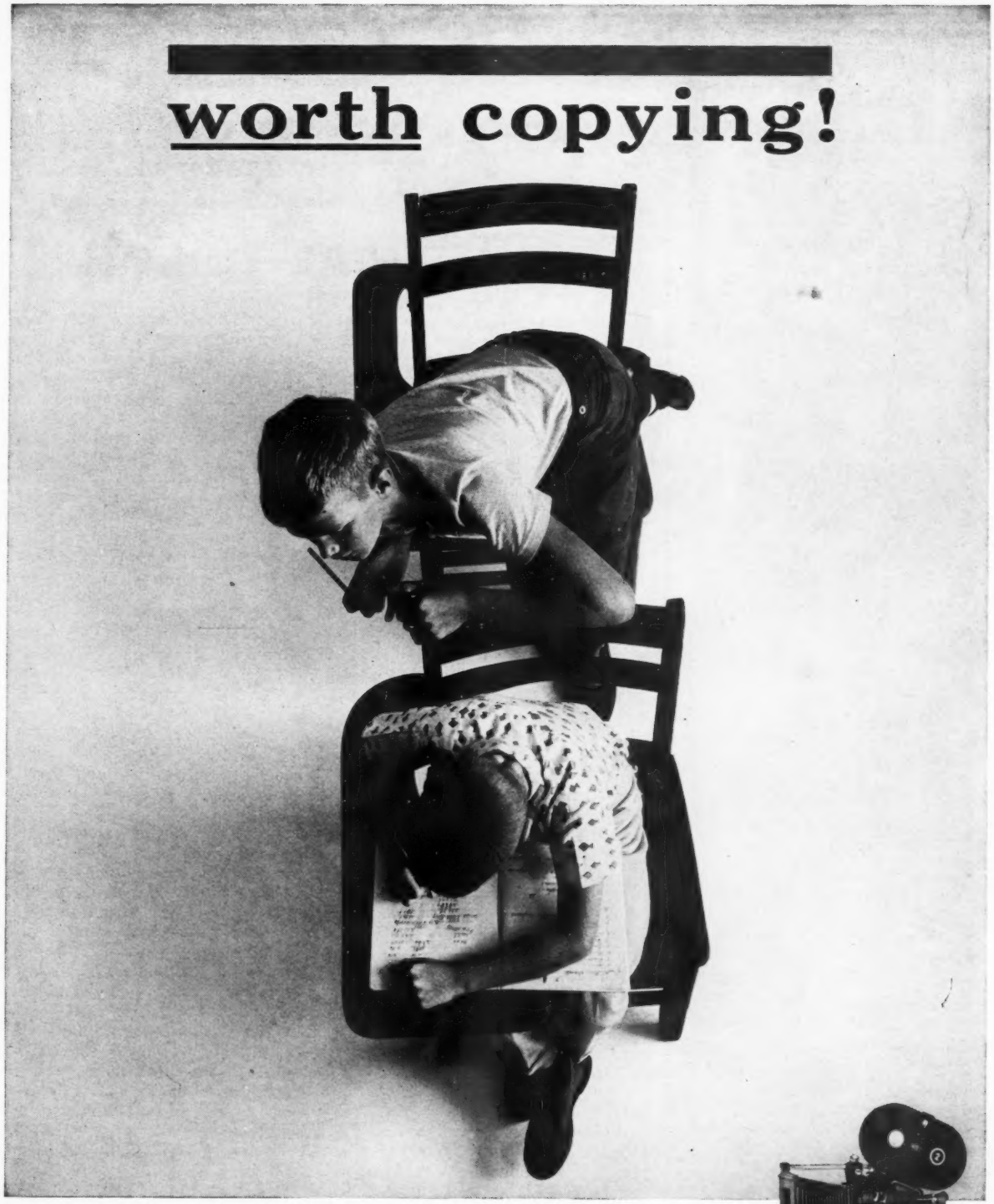

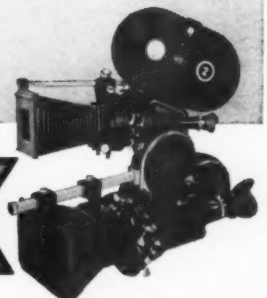

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Samuel Lang & Leonard Zoref

INDUSTRIAL COLOR

Photokina, a British industrial conference, new dye color method

This year brought another Photokina, and we headed for Cologne and the world's major photographic trade show with the Photographic Administrator, Inc., charter. At times during the trans-Atlantic trip it was quite comical watching a planeload of photographers taking pictures of each other. Roll after roll of film went through the PAI member's cameras. The photographic manufacturers made out very well on our excursion.

We were given a royal welcome by the German photographic industry, whose representatives did everything in their power to make our stay pleasant. There is no denying that the Photokina is the largest display of amateur photographic equipment on earth, but we were disappointed that our special interest was not gratified as well as we had hoped. There was a dearth of color processing and printing equipment for the professional laboratory, or even the small photographic department. Books could be written on the latest automated cameras, but it appears that the Europeans are leaving the development of processing equipment to American manufacturers. Probably the European approach is different because our labor costs are high while their material costs are high.

British conference

While in Europe, we took in the Industrial Staff and Cine Photographers' Conference held in London October 10-12 at the Central Hall, Westminster. This is an active industrial group of in-plant and freelance photographers. One afternoon was devoted to a symposium on industrial work in the United States, chaired by Morris Gordon, director of photography at Western Electric, president of the American Society of Magazine Photographers, etc. Panelists were William Sumits, chief of *Life*'s photo laboratory, Milt Frier of Leitz, Inc., and Len Zoref of this column and of Kurshan and Lang Color Service.

The audience numbered about 500 photographers who were interested in American products as well as techniques, but mostly the former.

Frier devoted his allotted time to discussing the increasing use of the 35mm camera in journalism and industry. Sumits showed a set of color slides of *Life's* new color laboratories, a most modern installation, while this corner covered trends in color photography.

The audience was intrigued by American photographers' use of color in contract bids, sales training, parts assembly, and industrial instruction. Apparently color is not as widely used in Great Britain as in the United States. The audience seemed not disappointed that E-3 Ektachrome has not been available in England until recently; they had heard of the somewhat trying shakedown cruises here. Their interest was quite aroused when they were informed that it is possible to obtain a color negative from High-Speed Ektachrome by processing it in the C-22 solutions. Normal development results in a film speed of about 400, while development for 25 min. will push the speed to about 1000. The resulting negative is unmasked, and the quality is fair to good. But of course there are times when the speed is necessary and this is the only method of obtaining a negative available to the photographer.

There was a sizable manufacturers' exhibition along with the conference. Little of the equipment shown is not available here, but two items interested us. Kodak, Ltd., offers a Kodak Transparency Illuminator, which is a much sturdier version of the American counterpart. And the Kodak, Ltd., 2¼ x 3¼ Colour Enlarger looks very promising. It has a band of photo-electric cells of various sensitivities which are

(*continued on page* 14)

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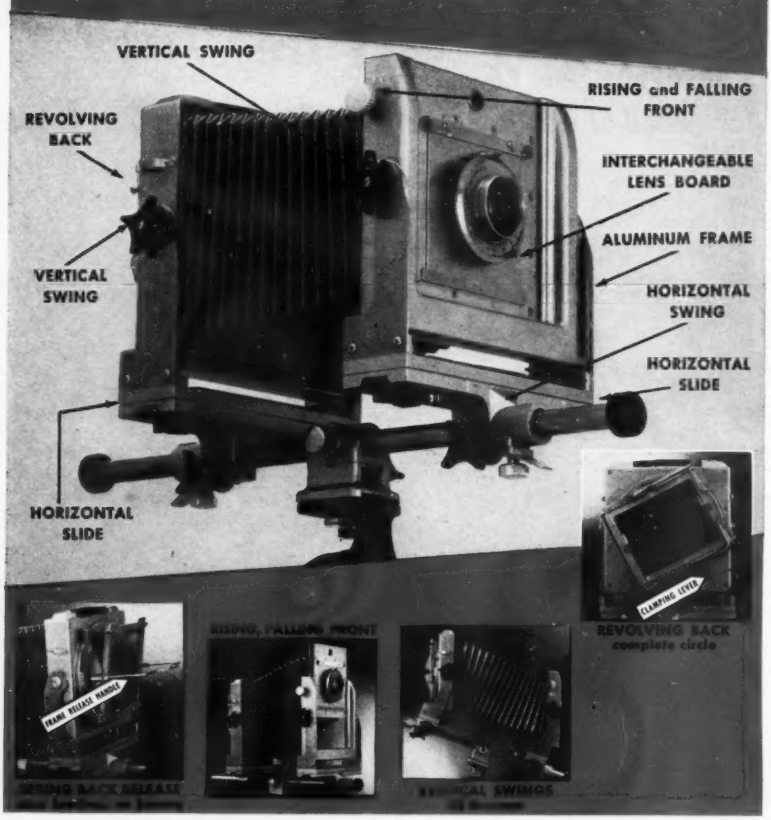

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INDUSTRIAL COLOR

(*continued from page* 12)

placed just above the lens. When the color negative is in place they read it and feed their data into a master control panel which the operator pre-balances according to his conditions. The color head of the enlarger is somewhat similar to the Agfacolor head—except that it is uncalibrated. It enables the operator to supply a continuously variable color balance to the negative. All adjustments are made on the control panel referred to above. By means of the controls, the operator is able to adjust the integrated flux of light through the negative so that it is the same for every negative. The claim is that the instrument will so accurately repeat itself that no calibration of the head is necessary.

Flexichrome on way out

The Eastman Kodak Co. has announced that as of May, 1961, Flexichrome stripping film will be discontinued. While its use has declined in the past few years, there is still a demand for it in advertising as well as for a few special applications. Some medical illustrators for example prefer to make their original rendering in black-and-white and then add the color via Flexichrome. All is not lost however. The Flexichrome stripping film will be superseded by a new technique. Regular matrix film will be used. It is quite similar to the Flexichrome stripping film, except it cannot be stripped from its base, and it lacks a little of the tooth of the Flexichrome material. The matrix will be prepared in reverse. The artist will then add his dyes to the matrix. The dye image will then be transferred to a sheet of glossy Dye Transfer paper. This resulting print will be much more brilliant than the untransferred Flexichrome matrix, and will accept retouching much more readily.

The loss, on the other hand, will be the ability to change the color at any time, as could be done with a Flexichrome print. A transferred print can not be completely reworked. This is not an entirely new system. It's rather common practice for artists to request flopped matrices, with the object of transferring the dye image to paper.—THE END

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David B. Eisendrath, Jr.

WORKING PHOTOGRAPHER

Comments on exposure meters; developments may shake a lag

Reports from the recent Photokina indicate that there may soon be an encouraging breakthrough in an area which has been bottlenecked for the past few years.

I'm speaking about exposure meters, for I feel that the meter manufacturers have fallen way behind in the equipment and materials race. Just take a look at the situation: there are lenses galore available today that are faster than f/1.4—and the recent introduction of an f/.95 lens for miniature camera work is probably only the beginning. And now we have films rated at speed indexes of 500, 1000, 1200 and pushable to even higher effective speeds. I remember back when Leica introduced an f/2.5 lens and Kodak boosted the speed of Super-X film from 24 to 32. Boy, that was fast (and yes, I'm that old!). In the past 25 years the film-speed-lens-speed ratio has moved ahead by over 100 times. But exposure meters are not yet in production that will keep up with this, that will allow you to take exposure readings at the low light levels at which we are easily able to make hand-held exposures, to say nothing of the short time exposures the industrial man has taught himself to use in low ambient light level situations.

Types and sub-types

Exposure meters commonly used today by industrial photographers are generally of two types: the photo-cell integrating meter type, such as the Weston, Norwood, GE, etc.—or of the brightness meter type. Of the first kind, some are designed primarily for incident light use, some primarily for reflected light use. Almost all of the better professional meters can be used both ways. As to whether it's better to read the light *falling on* a subject (a la Norwood, Spectra, or incident light technique) or to read the light *reflecting off* a subject (GE, Weston, etc.) depends a good deal on the man who will interpret the readings. Recently I took readings with eleven different makes of meters, and took them with both incident and reflected techniques. When carefully computed, all exposures were within one-half stop the same, well within the tolerances of shutter, lens and film.

One man's meat

Allen Stimpson, Eastman Kodak's meter expert, formerly at GE, and one of the most experienced engineers in the field tells me that of many tests made with *inexperienced* people, the reflected light readings were most consistent for *scenes* and over all views, whereas incident light readings were more consistent for *objects* of average brightness and contrast. *Experienced* workers, using some judgment and common sense, scored about the same with either type of meter for all types of scenes. The one thing the experienced pro did, apparently, was to use a little judgment as to subject brightness and scene brightness and correct the instrument reading to compensate for variations from average conditions.

Stimpson also points out that an integrating light meter is merely a statistical *sampling* device, which tells you what the average amount of illumination at the subject is. Statistically, of course, the more information we feed it, the more accurate will the information be—but only if the statistics fed in are relevant. This qualifies the argument about acceptance angle of a meter: should it, must it be the same as the lens being used to photograph with? Obviously it's not important if the meter looks at a fair sample of the average light. However, problems arise when a long lens, for example, is used to photograph a dark subject against a light background and a meter with a wide acceptance angle is used. The meter should be used to evaluate the light

(*continued on page* 18) ....

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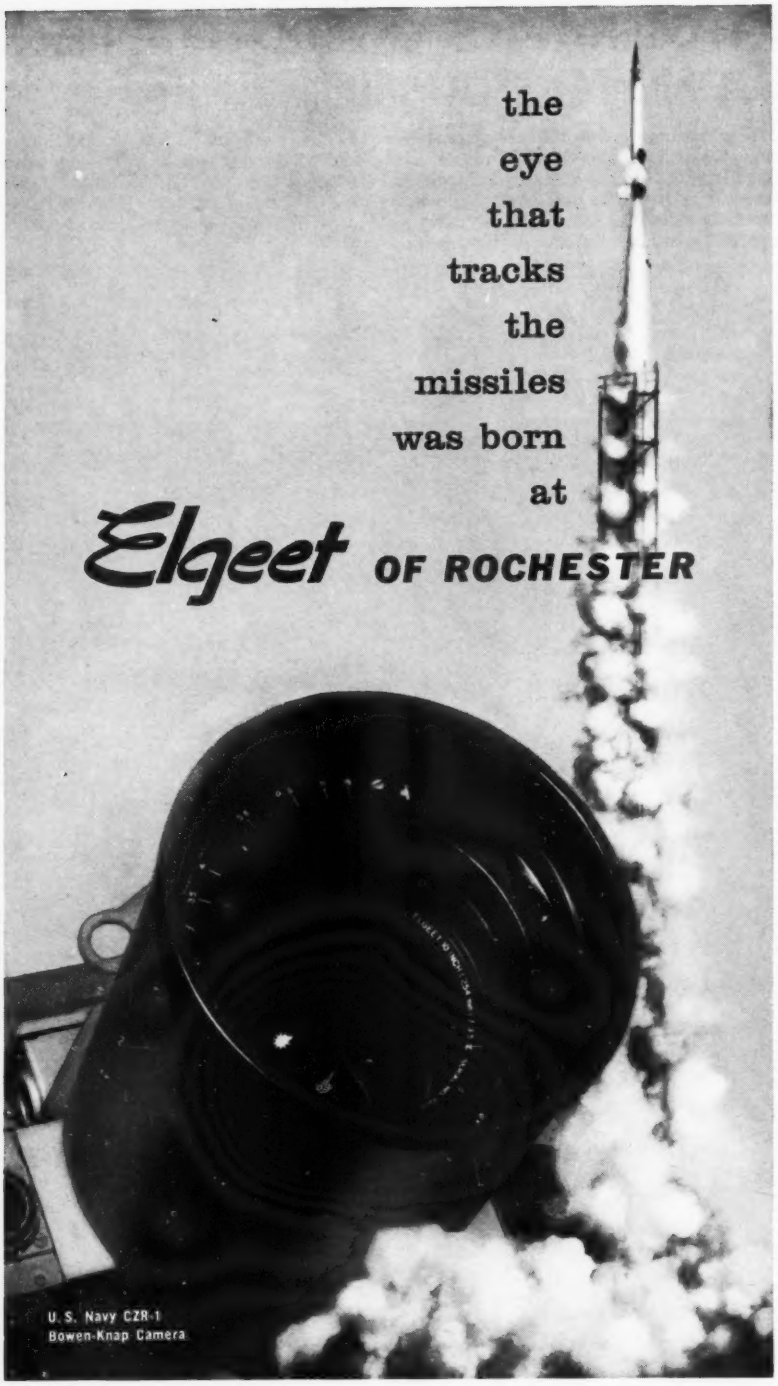

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WORKING PHOTOGRAPHER

(*continued from page* 16)

on the main subject and not be fed statistical information about irrelevant subject matter.

This is why many technicians and advanced professionals sometimes use a brightness meter to measure the light on only a small part of the subject; the statistical analysis now depending on the operator, not the meter. Such meters as the Elwood Foto-Meter, the S.E.I., or the Spectra Ultra Sensitive Brightness Spot Meter incorporate the use of a small spot or disc in a viewer. The scene is viewed by eye and the small spot placed over the subject from which a brightness measurement is desired. As an optical light gathering system creates a bright image for the eye (also a very sensitive device) the small area marked by the spot in the optical field is used to compare the brightness with a spot of controlled illumination (as in the SEI meter) or is read by a photocell system.

At any rate these meters have several unique advantages: they allow you to read an extremely narrow angle and therefore a specific area of the subject; they will read accurately at very low light levels. For example, the Elwood Foto-Meter Model Z-4 will read as low as 0.04 candles/sq. ft.; the SEI to 0.0032 candles/sq. ft.; and the Spectra Ultra Sensitive to 0.000032 with the aid of a booster and senstive meter.

The Spectra was designed by Academy Award winner Karl Freund and is probably the ultimate in brightness meters, inasmuch as it includes accessory optics, scales, etc., in the complete kit. Not a portable meter but a real lab instrument, it is nonetheless used extensively by motion picture studios and lighting experts. My personal choice of the meters currently available for reading extremely low light levels as well as very bright sources, and still within the portable class is the SEI meter which is made by England's Salford Electrical Instruments. Although expensive (over $150 new) it is portable and will give brightness readings in a foundry or carbon black plant. Ken Knollenberg of Bethlehem Steel tells me he uses it at the higher levels for taking readings from molten steel; I have used mine for reading welding arc and high-speed motion picture illumination. The Elwood Foto-Meter will not read at as low a light level, but is a reliable meter.

(*continued on page* 21)

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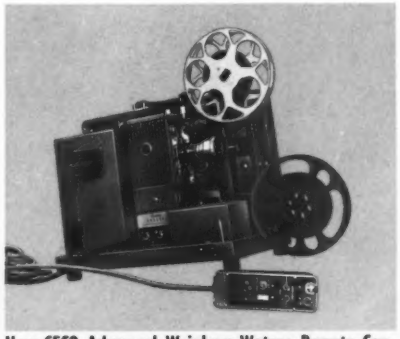

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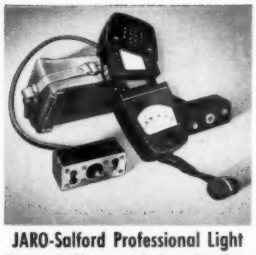

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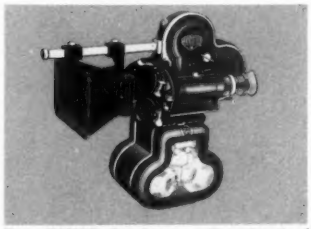

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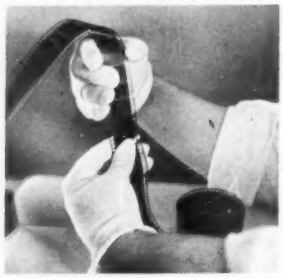

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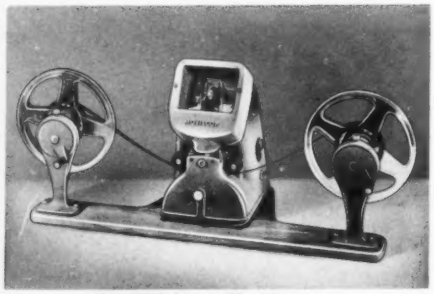

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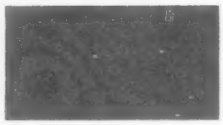

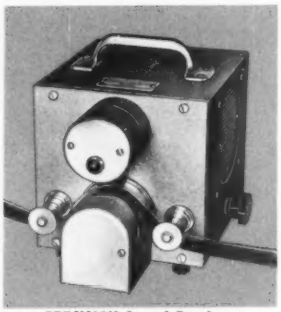

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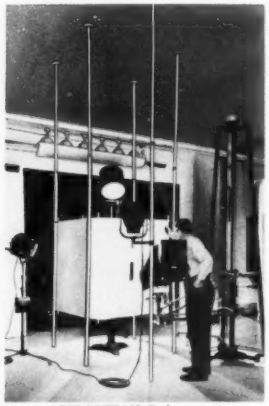

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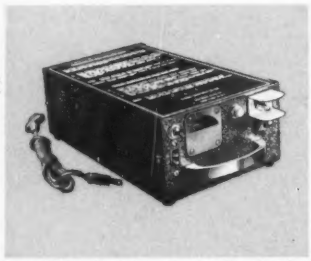

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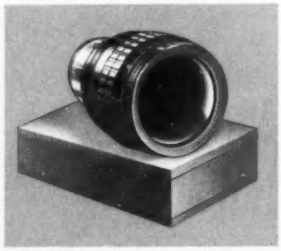

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(*continued from page* 18)

At the lower light levels, if you are working with a conventional reflection type meter, you might like to know that the GE PR-3 with booster cell attached reads at lower light levels than any other meter of this type I've found. The new Weston Master IV reads at almost as low a level, however, and the Leica Meter with booster cell is next.

One of the biggest bug-a-boos in taking readings at low light levels is that today with fast films and lenses we're making pictures at illuminations that are so low one can barely see the meter, much less read it. The GE PR-4 and the Weston Master IV both have needle-lock devices so after you've taken a reading of a dark subject you can lock the needle in place not only as a reminder of what the reading was, but so it will hold the reading as you go to a lighter place or strike a match or something to read it. No kidding!

Fast company

I am waiting for the meter to appear that has a built in dial light so you can read it in the dark situations you photograph in. Along this line, please note that the new Weston Master IV has the biggest, boldest, most easy to read numbers of any meter in my extensive collection. It's a pleasure to know that some meter manufacturers are aware of the problems of taking readings in dark locations (and when you get older!)

If you are using a photocell meter now that you are fond of and bemoan the fact that it's hard to use at very low light levels, a few tricks will extend its range by several stops. If you find yourself photographing in a situation where it's so dark the meter needle won't budge (and what industrial man isn't often in this predicament?) try taking a reading off a bright white sheet of paper. If the meter nudges, give five times the exposure. (Or to simplify the arithmetic, multiply the exposure index by five, set the meter dial accordingly, and then take the reading off a clean white sheet of paper.) In a pinch I've taken a reading off a clean white handkerchief and given four times the reading on the theory no industrial photographer's handkerchief is as bright as a clean white paper! Another thing to do is to make some test readings pointing

(*continued on page* 82)

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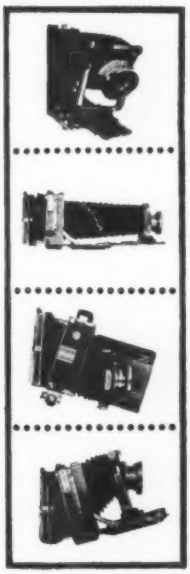
For more details, visit your franchised Linhof dealer.



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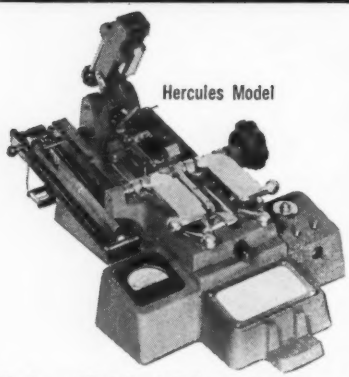

Newly modified Presto-Splicer butt-welds motion picture film, microfilm, acetate, mylar, Polyester, safety-base, paper . . . or any other kind of tape or film . . . AND INTERMIXES ANY OF THESE MATERIALS making a failure-proof, invisible weld that is literally the strongest part of the tape. Every splice you make will be a cleaner splice . . . a stronger splice . . . a PERMANENT splice, with

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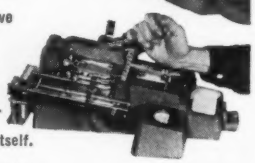
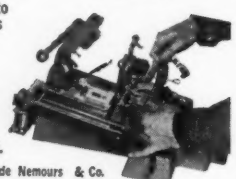
Slide handle toward you as far as it will go. This brings the special Mylar* tape with thermal setting adhesive into position.

Splice in the usual manner. Heat sets the adhesive but does not disarrange the molecular structure of the tape. The bond is permanent, stronger than the film itself.



Use the trimmer to remove the surplus tape. The entire procedure is so simple, so positive, that no special training is needed for your existing personnel.



*T.M. E. I. duPont de Nemours & Co.

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PMI IN-PLANT REPRODUCTION

Vernon Tate

MICROREPRODUCTION

Rubbery checks snap back at the passer with microfilm on the job

My friend the late George P. McCarthy, founder of the Recordak Corp. and pioneer of commercial microphotography, by profession was a banker. He once told me that the idea of microfilm reproduction (though the term had not then been invented) came to him one evening when he had taken his wife to a movie. The silent films of the 1920's used title frames to carry the narrative and dialogue. If a printed title, he reasoned, could be photographed on film and subsequently enlarged so that it could be read by a whole theatre full of people, then perhaps documents could be photographed on motion picture film as well. He set himself the task of finding out.

As a banker he realized the great possibilities in a process that would produce cheap facsimile copies of commercial documents, particularly of bank checks. The bank check is as much a convenience for the bank as for the depositor but at that time there was one serious defect. This lay in fact that paid and cancelled checks had ultimately to be returned to the depositor with his statement. The only records of the transactions remaining with the bank were its own ledger or similar entries. A number of sharp operators were beginning to exploit this defect and the banks had not been able to develop an absolute defense.

Money makes money

One of the methods said to have been quite popular was most ingenious. After establishing a checking account and keeping it in operation for a reasonable period of time, the customer would select a particularly busy period and present a check for some odd amount, say $871.23, and cash it. Quickly stepping into another line he would cash another check for the exact same amount. Both checks were perfectly good. The depositor would then wait until his statement and cancelled checks were sent to him. After tearing up one he would complain that the bank had debited his account twice for the same check and demand restitution. The records made by the bank would show two checks but in the absence of facsimile proof it was difficult for the bank to defend itself. Various methods to combat this practice were evolved but none was foolproof until the advent of microfilm.

This is not the place to relate the trials and tribulations that Mr. McCarthy had to surmount before his idea became the practical and very lucrative business that it now is. The important thing is the fact that he had an idea *and* the knowledge of a business application that was novel, needed and completely practical. He had, moreover, the drive and energy to carry it over the rocky road to success.

No magic in microfilm

It has often been said, and cannot be too frequently repeated, that microfilm is a tool, not a panacea, and its application requires complete mastery not only of its many ramifications but also full knowledge of the field in which it is to be employed. In other words anyone intending to use microfilm in a particular business field must be able to talk about the problems of that field with the professionals in it. A salesman desiring to sell microfilm for engineering drawings cannot know too much about engineering drawings and the problems encountered by the draftsman, engineer, systems man or administrator. The same facts hold true for any field.

Once an application has become established in one area or for one particular purpose, all manner of other applications will appear. Some are practical and some are not. Experimental work will usually prove out the value of an idea but the result of the experiment must be

(*continued on page* 24)

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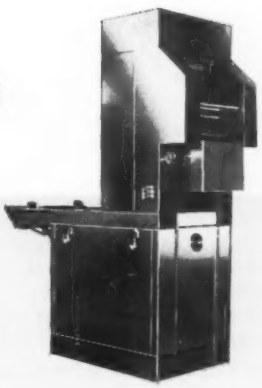

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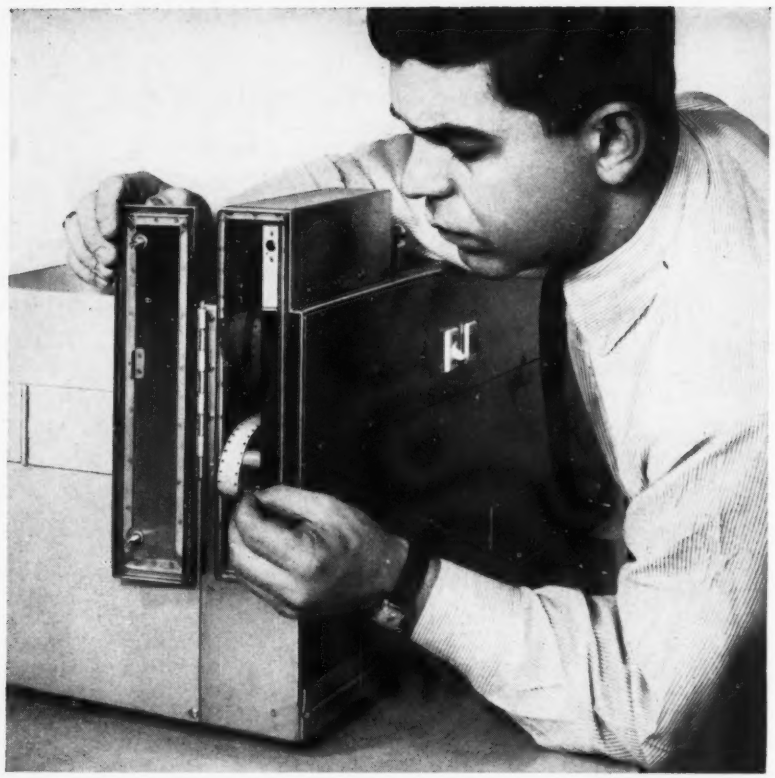

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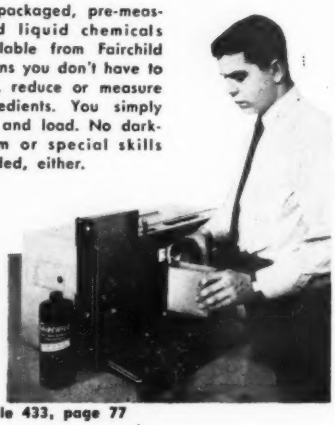

INDUSTRIAL PRODUCTS DIVISION
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Get more information. Circle 433, page 77

MICROREPRODUCTION

(*continued from page 22*)

weighed with real objectivity. Just because microfilm *can* do a particular task is no reason to use it; there may be another, better and cheaper way. At one time many business and industrial firms were encouraged to microfilm all the documents in a file in order to be able to discard the originals. There is something about a proposal of this type like having one's cake and eating it too. Still a careful analysis of needs and uses of the file may reveal that many of the papers can be thrown away without microfilming, for the use to be made of the film copies would be minimal or nonexistent. Records management principles should go hand in hand with microreproduction.

Loaded or not, it shoots

To continue, however, with bank checks, some interesting microfilm applications have developed for checks even before they reach a bank. Frequently merchants are asked to cash checks for their customers and despite usual precautions some of these have little or no basis in available funds; in other words they are almost pure rubber. Devices exist which photograph a check and simultaneously the individual who presents it to be cashed. These are to be seen in department stores, super markets and the like. The very presence of the device will deter most professionals and many amateurs. Sometimes the camera does not even contain film but still serves its primary purpose. This is akin to waving an unloaded gun in front of a holdup artist, for in event of fraud the photographic record is invaluable.

The recording problems faced by those who cash checks in any quantity are formidable. Lists of the checks must be made up manually including the name and number of the bank, the amount, name and address of the check casher and other pertinent information. After the check is bank endorsed and stamped, deposit slips with bank numbers have to be prepared. With microfilm only an adding machine tape is usually needed.

The basic reason for microfilming checks before they are sent to the bank is security against loss by theft or accident. Of course insurance can be procured to cover these contingencies and in small operations may prove to be less than the cost of filming; with the newly developed

(*continued on page 83*)

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We have made a lot of claims about the Nikon F, and others have, too – including many of your own colleagues. In fact, you may even have noticed how many of them have gone over to Nikon.

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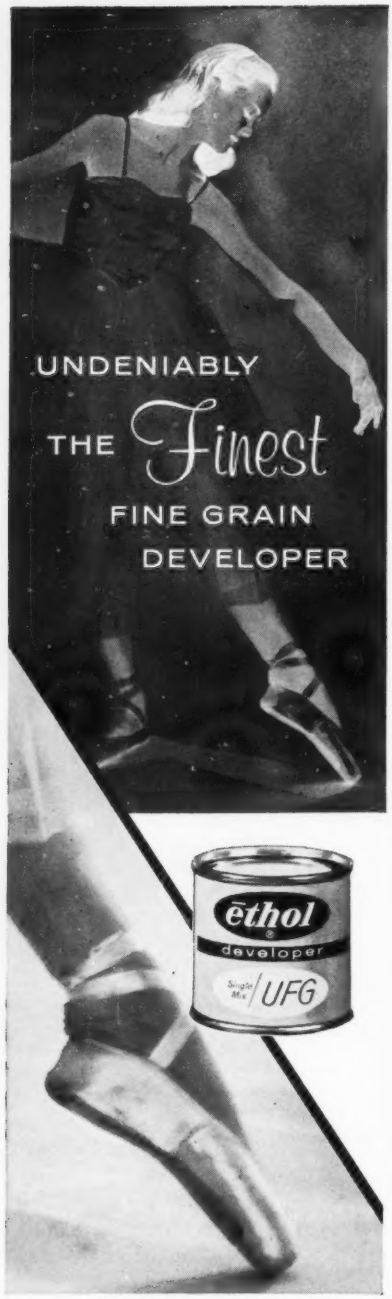

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PMI IN-PLANT REPRODUCTION

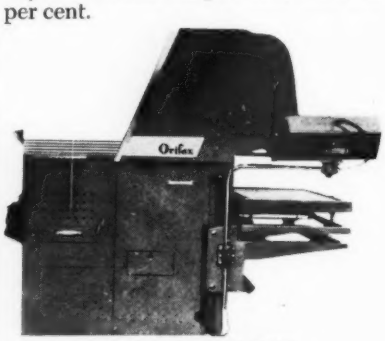
Herbert P. Paschel

GRAPHIC ARTS

Business show not quite so busy, but does display a few new units

In comparison with prior years, the 1960 National Business Show (New York Coliseum, October 24 to 28), was not only a smaller show but also rather barren of new ideas and equipment for office copying and duplicating. Several items, however, are worthy of mention. It may be that we are in a period of consolidation, absorbing the rapid advances already made in the field of business reproduction.

The ORIFAX "Model 202" is a combination of an auto-focusing copying camera and the mechanism for processing an electrostatic image. Copy and electro-conductive paper are loaded manually. Charging the paper (sensitizing), exposure and development are then performed automatically. The delivered print, in an "unfixed" state, is then manually inserted in a heat chamber. Before fixing deletions can be made merely by erasing any unwanted image area. The output can be either a lightweight copy print or an offset master. Maximum image size is 8½ x 11. The copyboard will take original material up to 14 x 20. The camera will enlarge and reduce to any size within 55 per cent and 150 per cent.



Orifax "Model 202"

The ORIFAX machine is a product of the Oriental Photo Industries Co., Ltd., Japan. The electro-conductive paper was developed under licensing agreement with Radio Corporation of America (Electrofax Process). The latter is an adaptation of the well known Xerox process. While this device offers nothing radically new, the price, $4000, may prove attractive to those who desire an electrostatic copying and offset platemaking system.
Source: Mitsui & Co., Ltd., 530 Fifth Avenue, New York, N. Y.

Heat sensitive copying papers

If you come up with a good idea and develop a successful product and business, you can be sure of one thing—it won't take long before you have plenty of competitors. Until recently 3M was the sole supplier of copying paper for their heat sensitive system (Thermo-Fax). Three new brands of heat sensitive paper were in evidence at the NB show, all advertised exclusively for use with Thermo-Fax machines. Among the claims made for the new papers were lower price, greater legibility and durability (greater resistance to heat and aging).

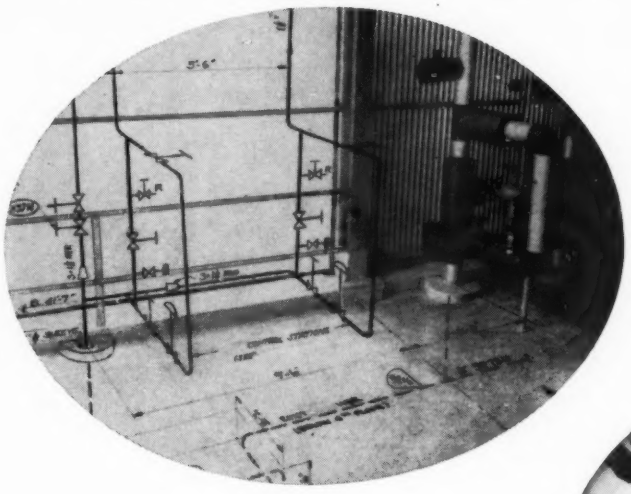
The new papers are all of the opaque type; white on one side, dark on the reverse side. This is the type of paper that was first used with the Thermo-Fax process and later discarded in favor of the translucent paper currently used. Reports have it that the field is now wide open and several other brands will soon appear on the market to challenge 3M's unique position.
Sources: Instant Copy (Interchemical Corp.); Perfax (Perry-Sherwood Corp.); Calcop (Calor Copy Corp.).

Good old neg.-pos.

With the introduction of such methods as Gevacopy, Thermo-Fax and Verifax, it was reasonable to assume that the older, two-stage negative-positive system would be rendered obsolete. But no. Recourse to a single bath, stabilized processing technique has given new life to the old method. The Royal Scot Stabilization Process was featured by Hunter Copymore Equipment Co.

(*continued on page* 28)

CRONAFLEX®: best engineering films you can use



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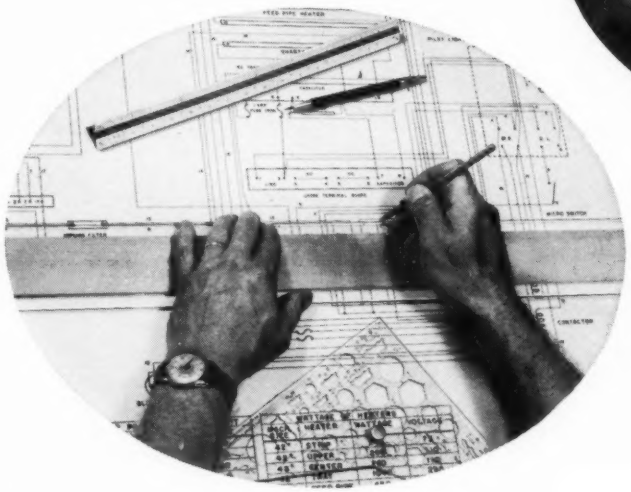
CRONAFLEX copies are free of kinks and tears. Its rugged and flexible base adds years of life to your drawings.



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CRONAFLEX films are now available in four types: (1) Direct Positive Film; (2) Contact Film; (3) Projection Film; (4) CRONAFLEX Drafting Films. It's the most complete versatile line of engineering reproduction films you can use. For more information, contact your Du Pont Technical Representative, or write: E. I. du Pont de Nemours & Co. (Inc.), Photo Products Department, Wilmington 98, Delaware. In Canada: Du Pont of Canada Limited, Toronto.

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GRAPHIC ARTS

(*continued from page* 26)

From one to any number of copies can be made with their system with the same speed and ease as other systems. For multiple copies from one original a negative is first made. From this as many positives as desired are then made by repeating the exposure and developing cycles. Single, readable negative copies can be made in one step. The stabilization process, it is claimed, makes either negative or positive copy a permanent record. Negatives can be stored and reused indefinitely.

Silk screen press

An inexpensive ($69.50), flat-bed, hand-operated silk screen press of simple but effective design has a potential for a wide variety of applications in industry.

Although its primary function is as a hand-operated mimeograph duplicator (it actually uses mimeograph stencils) the DUPLI-GRAPH permits applying an ink image to a wide variety of flat surfaces. Thus it can be used to print on paper, card stock, metals, plastics, wood, cloth, glass, etc. Such items as dials and nameplates, for example, can easily be produced. The machine permits transferring an image to materials as thin as paper and up to several inches in thickness. Since the screen frame can be unhinged it becomes possible to print circuit diagrams and maintenance instructions directly on equipment housings.

Dupligraph

The press is designed to take any standard typed, hand drawn or electronically cut mimeograph stencil. With some improvisation, other types of stencils could undoubtedly be used. Additional screen frames are available which could be used for making regular silk screen stencils by the photo-stencil method. Source: Identification Systems Co., 246 Fifth Avenue, N. Y. C.—THE END

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Free booklet gives details on Ektalith Method and equipment for roomlight or darkroom installation. Call your Kodak Ektalith dealer or write Eastman Kodak Company, Graphic Reproduction Division, Rochester 4, N. Y.

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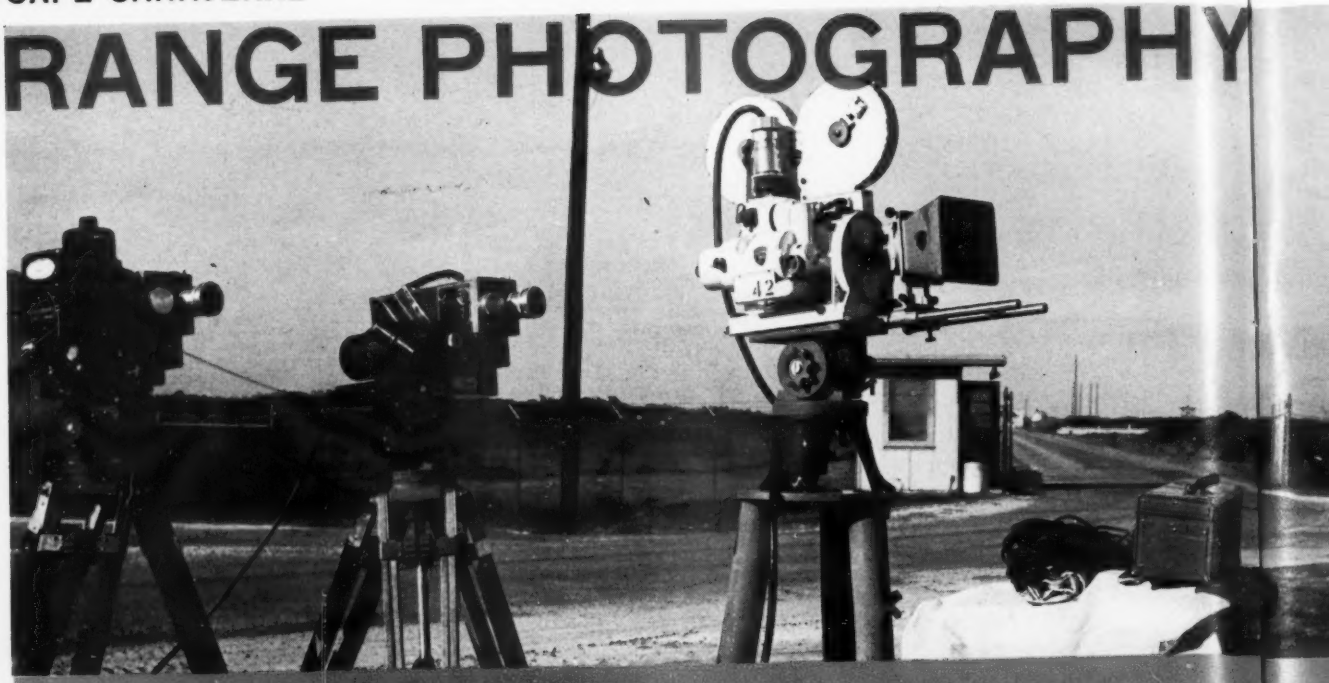
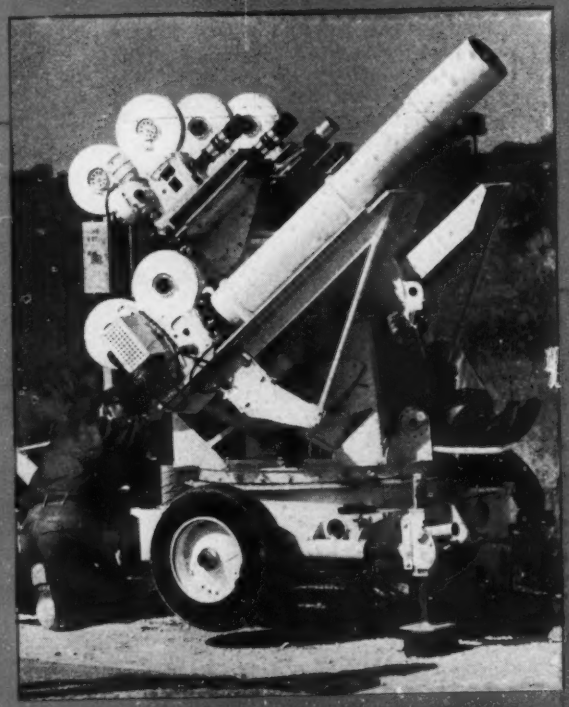
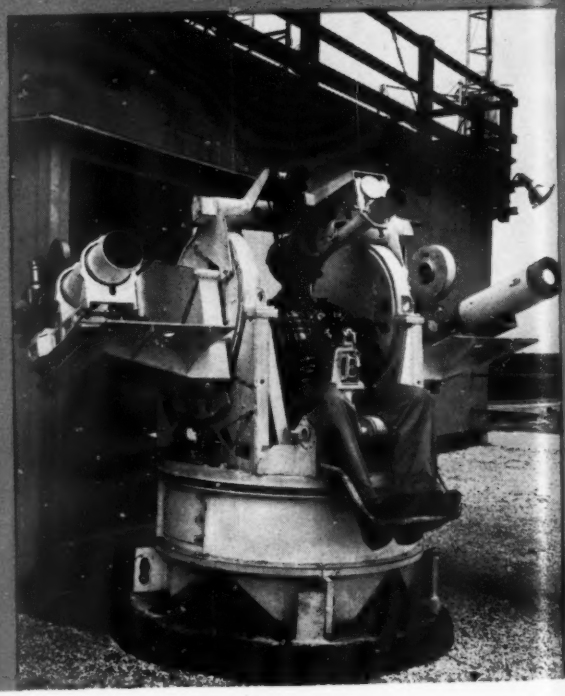
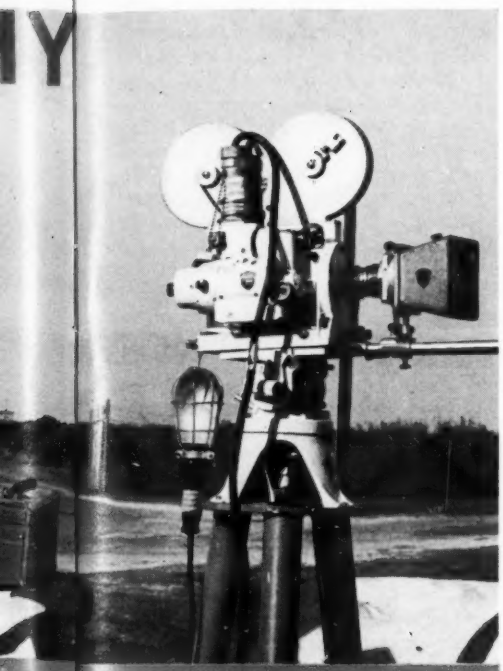
RANGE PHOTOGRAPHY

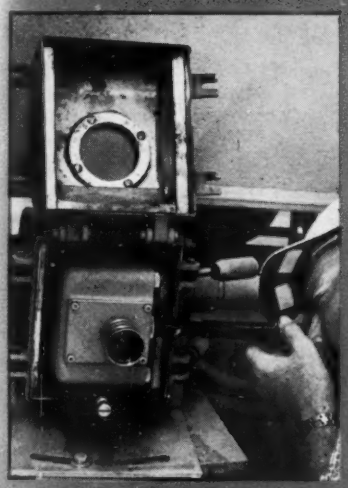




Camera, cameras, cameras. Over $5 million worth of photo equipment is used to handle the photo requirements of the Air Force Missile Test Center. Each of the cameras lined up for a test firing is set to provide a specific phase of the data during the firing program.







Tracking cameras come in mobile or fixed models, provide data on the missile's flight *(left)*. Milliken high-speed camera *(above)* is adjusted on launching pad to cover rocket ignition. Protective box guards camera from terrific heat and the explosion at lift-off.

Range Photography has one assignment: photograph everything that takes place at Cape Canaveral. There are no second chances. Every shot must be good on the first take despite heat, explosions, bugs and humidity. Using top photographic talent, good equipment and superb organization, the job is accomplished

Photography at Cape Canaveral is twins; one being Metric Optics, the other, Range Photography. Apart from using different cameras, the two sections are separated not only by the organization chart but by their assignments.

As far as Metric Optics is concerned, photography is only a means to an end. It is the best way, at present, of recording data on the behavior of missiles in the air. As it is, the demands for data are pushing against the limits of photography and driving it toward an eventual marriage with electronics to pierce the limits.

Range Photography, on the other hand, is responsible for making a complete photographic record of everything that is going on at the Cape, from the umpteenth visit of a not-so VIP to the successful retrieval of a data cone section 5000 miles from the home-base launch pad. In between there are such jobs as tracking, PIO work, training films, audio-visual briefing materials, etc. If it is photographic, it is Range Photography.

The two sections are completely independent of each other. About the only time they come together is at the tech lab at Patrick Air Force Base, some 15 miles north of the missile range. Patrick supplies administrative and logistical service as the headquarters of the Air Force Missile Test Center. Cape Canaveral is the Atlantic Missile Range where the actual tests are made. It has about the same relationship to Patrick Air Force Base as any rifle range might have to the training command using it.

Exposed film from both sections is developed at Patrick as part of the control system used to minimize operational variables and insure a high standard of quality despite extremely variable light and climatic conditions.

To cameramen used to some degree of control over their exposed negatives, this separation between field and lab (a separation which is not only geographical but functional and administrative) may seem a difficult relationship to work with. In a way it is; there is no way of using the lab to make up any photographic deficiencies. This, however, was the method behind the apparent madness.

One of the first elements in good engineering practice is to reduce variables until there is only one factor which must be controlled. This is exactly what was done. All processing at the Tech Lab is rigidly standardized and constantly checked. Therefore, any deficiencies will be due to photographic practice at the range rather than lab practice. In some cases, the extremely uncertain conditions under which pictures must be made are responsible for poor photographs. In other cases, it may be photographer's error or a faulty operational system. By making sure errors are possible in only one area, picture taking, quality control engineers can isolate and remedy the cause more quickly.

This system, with its rather stringent SOP's and control systems is necessary for one basic reason: the

pictures made by both sections are extremely important and, in many cases, can never be duplicated. If a missile blows up on the launching pad, the photographic record can help tell why. If it veers off course and has to be destroyed, the camera can help tell why. But if there are no pictures, regardless of reason, then the whole test was a waste. Canaveral is a test center, not an operational base. If the failures and successes are missed because of poor photo performance, the whole program may just as well have never taken place. Photography is not only indispensable, it must be infallible.

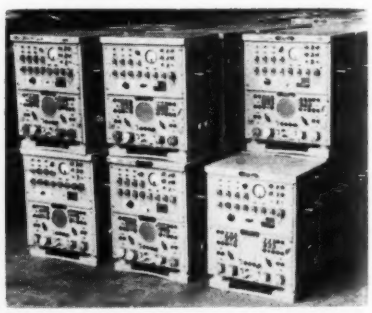
Both sections are not only service units for base operations but supply range users with photo coverage. A range user is one of the more than two dozen firms which, in some way or another, have contributed to the development of the missile being tested. The role of these firms varies from a prime contractor who makes the air frame, the body of the missile, to a subcontractor who may supply a timing device for one of the control systems. The extent of the participation is relatively unimportant in terms of photo coverage. Under Air Force contracts, they are all entitled to photographic coverage appropriate to the activity.

The type of coverage may vary because of the customer's needs. One firm may want a complete documentary of the test operation for use in a public relations film. Another firm may just want to record the operation of their component in the missile, not caring about the test or pre-test procedures. With some firms, a handheld newsreel-type film is sufficient; others may want a Hollywood treatment. With some, a pictorial film of the bird in flight is adequate. Other customers may want a complete report on the navigation of the missile in flight. Regardless of the requirement, the two photo sections at Cape Canaveral have to serve these customers. Much of the burden falls on Range Photography because its assignment is the more inclusive of the two.

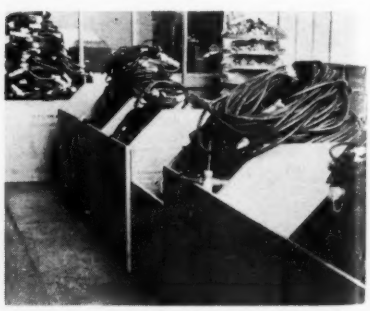
Range Photography is divided into four sections, each of which covers a definite area of photo operations. Planning, coordination, direction and communication are handled by Photo Operations, headed by Dave Kovljain. Procurement, storage and maintenance of equipment is handled by Photo Facilities, headed by Alex Mahan. The actual camera work is handled by two sub-sections, Pictorial Services, headed by Robert Tschiemer, and Range Tests, under Paul Baumforth. Managing all Range Photography is John Piszczeck, a former RCA engineer. He joined the RCA Missile Test Project in 1954 and was named Manager, RCA Range Photography, in 1959.

Planning for this coverage is handled by Photo Operations. This section receives all requests for coverage and coordinates them, planning the type and amount of equipment needed, locations, personnel, field communications, etc. All requirements are entered on a master Photographic Coverage Plan which lists the equipment needed, the data to be obtained, the type of film used and in what amount, the operating conditions and the desired results. For example, if PIO requires pictures of fueling operations, the PCP may call for a 35mm Nikon with f/1.4 lens, Plus-X Pan film, handheld and used at the launching pad. On the other hand, there may be a call for docu-

Supply Area in Hanger G, center of Range Photography activities. Despite huge amounts of equipment, requirements for complete coverage strain resources.



Timers used for firing cameras by remote. A box controls two cameras.



Cable. Miles of cable are laid during a test for automatic camera firing.

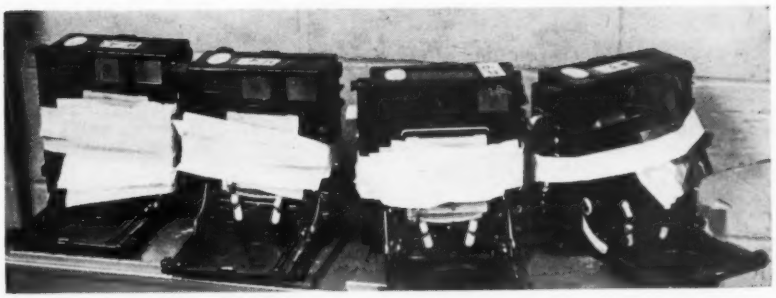
mentary coverage of the launch and missile flight. Ths may require a high-speed camera, mounted on a tripod at a specific point, remote-controlled from the blockhouse.

Once the planning is underway, it is up to Photo Facilities to provide the equipment. This assignment covers not only storage and issue but repair and procurement. There are about 30 people in this section, including 14 persons in the repair shop.

Alex Mahan, manager, estimates that he has about $5,000,000 worth of equipment on the shelves of Hangar G, center of photo activities at the Cape. This includes still and movie equipment for Nikons and Graphics, Mitchells and Eyemos, Arriflex, Millikin, Fastax, etc. Film costs run well over $50,000 a month, about 85 per cent of it being used by Range Photography. The cameras are stored along rows of shelves, lockers and bins. Film is kept in an air-conditioned van with temperature and humidity controlled to be as close to outside conditions as possible. The variety of film used matches the variety of cameras; Panatomic-X, Super Hypan, Linagraph Shell Burst, Superior, Polaroid, Ektachrome, etc. The impression derived from a tour through Hangar G is that somebody decided they needed certain items and ordered three dozen of each. Actually, cost-control is important and repairs and improvisations are more common than purchase orders and authorizations.

Photo Facilities begins issuing equipment hours before the scheduled test. They must match all specifications as listed on the master PCP. If a 35mm movie camera should have a 120mm lens, it has a 120mm lens, not a 90mm or 135mm. An average of ten pieces of equipment goes with each camera—filters, tripod, extra lenses, holders, film magazines, etc. All of this equipment has been inspected and repaired, if necessary, by the repair department before being put on the shelves for re-issue.

Once the test is over, all cameras and equipment are checked for possible damage. Very often, the damage is slight, such as mosquitoes in the viewfinder of a movie camera or sand in a Raptar shutter. In this case, the repair shop does the necessary work. Sometimes, however, the damage is such that only a complete rebuilding will bring the equipment back to life. This



Casualties. These Busch press cameras survived test firing, but not well. Repairman *(below)* adjusts film gate of magazine from high-speed camera.

may happen when an explosion knocks over a camera tower or when there is a mishap and the cameras on the pad are hit by a flying missile. If the estimated repair cost is excessive, about 2/3 or 3/4 the original price of the camera, the damaged item may be scrapped. If there is a possibility of repairing without excessive cost, it is handled by the shop, or by the manufacturer of the item.

In addition to repairs, the shop may modify cameras to serve the purpose better. For example, timing devices were built into one movie camera. Another modification is changing the aperture of movie cameras from Academy standard to full frame size. (Academy standard is slightly smaller to allow for a safety factor. However, this is not needed for instrumentation purposes.) On some high-speed cameras, the rotating prism is replaced by an intermittent prism for special requirements.

Some cameras are charged out personally but most equipment is charged out to a test function. The reason is that the large amount of equipment involved and the uncertain length of the test make personal signatures too slow a method for charge-out. Ideally, what goes out comes back in. While this is not always the case, missing equipment is quite rare.

The equipment supplied by Photo Facilities is used by the two operating sections, Range Tests and Pictorial Services. The former has the responsibility for complete documentation of all tests, including engineering sequential footage. The latter is responsible for general photo coverage of activities at the missile test area.

When cameramen of Range Tests pick up their equipment, they take it out to one of an average of 26 camera locations used for a test. The equipment varies with the location. Close to the missile are high-speed Millikins and Fastaxes to record ignition, release and other events preceding lift-off. Around the launch area are 16mm, 35mm and 70mm cameras, from Cine Specials and Mitchells to Hulchers and Photo-Sonics. Some of these cameras are on towers while others are on tripods whose legs are reinforced with sandbags. All have

various lenses, films and operating speeds to record particular details of the test. Each camera fills a different requirement for information. There is no duplication so that if there is a malfunction, the data which that piece of equipment was supposed to get will be missing, making the test record incomplete.

Further back, about ½ mile from the launching pad, are mobile tracking cameras. These are 16mm and 35mm movie cameras, both regular and high-speed, used with long focus lenses, 20 to 120 in. They are used on converted .50 calibre machine-gun mounts and are sighted by the operator using very slight movements on the control handle. Because of the narrow angle of view of these lenses, the operator must be quite skillful to avoid losing his target. The cameras and mounts are exercised daily to prevent both man and machine from tightening up for lack of use.

Each cameraman is assigned to a particular tracking camera so that he learns its eccentricities and gets the "feel" of the instrument.

While the major concern of Range Tests is the preparation and operation of the missile, the cameramen of Pictorial Service are getting still and movie coverage of the event from the news aspect. These pictures may show anything, from the strain on blockhouse personnel during the countdown to the beauty of a missile at lift off.

A minor paradox of photography at the Cape is that some of the finest photos of the most advanced technology, missiles and rockets, have been made with the classic form of camera, the 8 x 10 view. Among the still men, Chuck Rogers has gained a fine reputation for his pictorial work, done mostly with the 8 x 10 Deardorff.

An unusual aspect of the personnel set-up at Canaveral is the unionization of the photographers working there. The contract is held by Local 666 of IATSE, a Chicago local. Under this contract, the union has three days in which to fill any vacancies which might exist in the Cape Canaveral photo staff. If, within three days of notification, the union cannot send anyone down, RCA is free to hire photographers on the open market.

The pay scale at the Cape is the union scale at Chicago, ranging from $130 for second cameramen to $210 for directors. Leaders and coordinators are not unionized, being considered part of management. One of the minor reasons for unionization, incidentally, was to secure a more uniform job and wage classification since men of varying skill and experience were often hired for similar jobs at similar pay. Another factor was working conditions.

While the work at Cape Canaveral is interesting, it is not exactly a photographer's paradise. Most of the photographers interviewed mentioned the heavy workload, especially in terms of hours worked or spent on a job. Frequently, there would be "holds" on a test which might add several hours to what could have been a one hour assignment. (A "hold" is an interruption in the count-down prior to launching a missile caused by a last-minute repair or inspection or any other condition which might cause the missile to malfunction. When a hold is announced, the count-down stops. When the discrepancy is corrected, the count-down resumes from where it stopped.) On the management side, this condition is reflected in mounting overtime costs. The extreme temperament of the subjects is one factor in organizing a shift system so as to get maximum photo coverage with a minimum of overtime charges. It does not always work out as planned; many photographers have been on jobs hours after they were scheduled to go off duty, waiting for a missile to be launched.

Other problems faced by cameramen include weather and humidity. Often it is so damp that cameras left on the field for remote operation are found full of water. Insects and small animals find cameras ideal for light housekeeping. Scotch tape has become one of the biggest items in the photographic supply catalog, serving as a general sealing, protective and odd-job gizmo.

A skirmish over 35mm was another engagement in which the decision went to the cameramen.

Problems. *(l. to r.)* Dave Kovljain, Photo Operations manager, Jack Piszczek, Range Photography manager and Tony della Bova, director, discuss coverage.

Chuck Rogers, pictorial ace of the photo section, examines color shot.

Many still photographers felt that the 4 x 5 box was unnecessarily restrictive, making it more difficult than usual to take adequate coverage of Cape Canaveral activities. The pictures seemed to lack the oomph or impact enjoyed by 35mm shots. Finally, permission was granted to get Nikon Reflex outfits. It was argued that the faster lenses (f/1.4 versus f/4.5) and the ease of handling would more than make up for any loss in print quality resulting from small negatives. While there is nothing definitive yet, rumor has it that claims made on behalf of the 35 are proving true.

Scratch any cameraman and you will find a gadgeteer and an innovator who tries to improve on the store-bought product. This is as true of Cape Canaveral, where equipment runs into the millions, as at the local paper where a battered Graphic continues to breathe against all laws of man, nature and mechanics. Most of the innovations are efforts to meet the unusual challenges presented by the birds. No matter how fast a shutter is, it could be faster. No matter how sharp a lens is, it could be sharper. No matter how fast a camera can operate, it could be faster.

The Speed Graphic focal plane shutter has a top speed of 1/1000 sec. By narrowing the slit in the shutter curtain, 1/2000 sec. is obtained. An increase in tension of the shutter spring and the top speed goes to 1/3000 sec.

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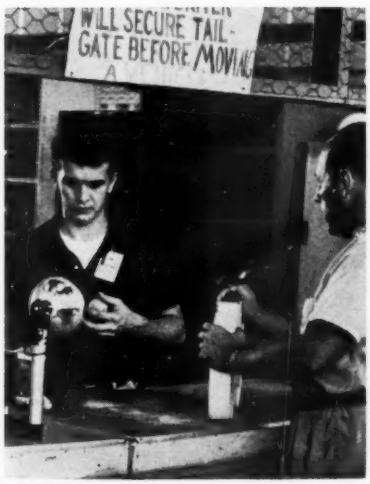
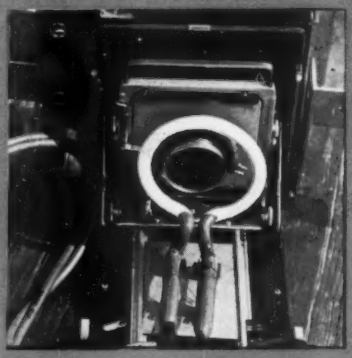


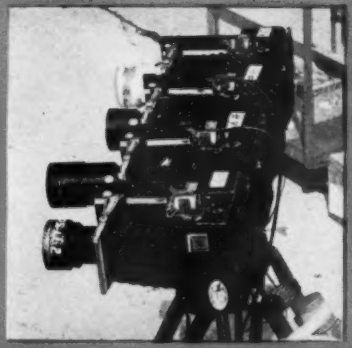
One of each. Test film is delivered to Hanger G for processing at lab.

GADGETS MAKE LIGHT WORK

Small shutter *(left)* used on rear element of long-focus lens provides higher speed than normal between-lens shutter *(right)*. Front shutter is used only for diaphragm control. Exposures are made using solenoid-equipped shutter at rear of lens. This modification increases possible top speed from 1/200 to 1/400 sec.



Ring-light *(left)* is used for shadowless illumination on close-up work. Fish line *(right)* provides an easy way to send messages from second floor of Hanger G, where offices are, to the main floor where photographers and supplies are kept. All four sections of Range Photography are quartered here, operating base for photo coverage.



Pictures from afar. Graphics *(left)* rigged for remote operations of back shutter by using solenoid. Groups of four cameras can be fired this way, controlled visually from blockhouse. Bob Special *(right)* attaches Nikon Reflex and special adapter to long focus lens. These adapters, made in the shop here, permit using 20- and 40-in. lenses.

PHOTOGRAPHY AT CAPE CANAVERAL

Missile behavior can be plotted from in-flight photos carefully made to permit accurate analysis through matching camera, subject positions

Basic to any testing process is the acquiring and interpretation of complete data which can be used for further testing and development. This is especially true as the tests increase in complexity and expense. Probably the top of the testing pyramid, as far as large scale programs go, is the missile testing conducted at the Air Force Missile Test Center and the Atlantic Missile Range, Cape Canaveral. Here, test data is not only vital but it can become irreplaceable should the missile be destroyed in the testing process. Data collection is accomplished using several methods. Not the least of which is photography.

Data acquisition by photography is handled by Cape Metric Optics, the second of the two photo groups at the range. Unlike its cousin, Range Photography, the end result as far as Metric Optics is concerned is not the picture that is made, but the information which that picture can convey.

This information involves the flight characteristics of the "birds," divided into two general categories. The first concerns spatial relationship; how fast does the missile travel and where does it go? The second data group is concerned with attitude; specifically, how the missile behaves while in its trajectory. This information includes yaw, roll and pitch.

These are nautical terms which mean the same applied to ships or missiles. Yaw is the side-to-side movement which tries to divert a moving body from its proper course. Roll is the up-down-turning movement familiar to all seasick sailors. Pitch is the up and down movement, similar to that made by a ship as the bow buries itself in an oncoming wave. Ideally, a moving body should travel a true path. In practice, this ideal is approached but is very seldom attained.

The two categories, spatial and attitude, comprise the body of Metric Data, "the recording of events by photo/optical instrumentation with appropriate space/time coordinates to form the basis for accurate measurements subsequently presented as numerical or graphic data."

Metric optics, in short, is the making of photographs at suitable, fixed times from known positions. By comparing the photographs with the cooordinates, the flying characteristics of the missile can be de-

R. P. Murkshe, Metric Optics manager, is trained as an engineer.

ROTI installation, one of three, is air-conditioned and highly automated.

termined. The degree of accuracy depends upon the position of the cameras, the quality of the instruments and the ability to interpret the data recorded on the pictures. Cape Metric Optics is concerned with the first two phases, the acquisition of data (through its cameras) and the recording of data (on the proper type of film). The processing of the film itself and the reduction of the data from film to usable form, are the responsibilities of sections at Patrick Air Force Base some 15 miles away.

The need for extreme accuracy has led to the development of highly specialized precision equipment to handle the desired data-gathering functions. Each piece of equipment handles a specific data acquisition responsibility; there is no duplication or overlap.

Precision can be translated into dollar signs and the per capita investment for each of the 55 men in Cape Metric Optics must be among the highest in the photographic world, averaging about $70,000 apiece. The value of the total inventory is estimated at over $4,500,000, with such specific items as ROTIs at $580,000, IGORs at $160,000 and Ribbon Frame cameras at $43,000 each.

What does the taxpayer get for this money? He gets an instrument capable of giving missile positions over a 5000-mile range to an accuracy measured in fractions of an inch. In the go-for-broke world of missiles and rockets, such accuracy is essential regardless of cost.

Supervising the operation is R. P. Murkshe, a veteran of eleven years in missiles. (This field is only about 15 years old as far as veterans go; pioneers are those who fooled around with rockets before World War II.) Like many photo supervisors at the Cape, he is an engineer rather than a photographer, formerly an optical engineer in RCA's instrumentation engineering section.

The large number of engineers in RCA's photo operations reflects the highly technical nature of the work done, where picture-taking is almost a by-product of research. Many of the people in Metric Optics were electronics-types who learned photography, rather than purely photographic people. Actually, a new type of technical hybrid is being developed through extensive training programs, who can handle the complex electronic-photographic systems used in missile photography. This job includes not only operation but basic maintenance. (More complex problems are referred to base shops or back to the camera manufacturer.) The maintenance times vary with the equipment, but at least 25 per cent of the available man hours are spent on this function.

With the variety of climates (heat and humidity) plus fungus and assorted animal and insect life, keeping equipment in first-class condition is a problem. The astrodomes which house the ROTIs, for example, are de-humidified and carefully air conditioned so that the weather inside the dome and outside is the same. This helps avoid shock which can throw the delicate instrument out of alignment. Daily cleaning and dry runs are necessary to keep the tracking mounts operating smoothly.

Despite problems of environment, the requirements of the range users can be met satisfactorily because of careful organization, skilled personnel and standardized procedures for operation and quality control. As with all Cape photography, the basic requirements are established by the users, or customers, rather than by the section itself. In the case of Metric Optics, photographic coverage starts when the missile contractor supplies the planned trajectory of the missile to be tested. In addition to fixed stations, mobile stations are set up at carefully plotted sites. The sites are selected to give the most complete coverage possible of the flight path. The careful plotting is necessary so that the location of the missile in flight can be charted at any given time by referring to known positions.

Teams are sent out a day early, if necessary, to set up the equipment and make sure it is operating perfectly. The type of equipment used and its position during the test are decided by the Metric

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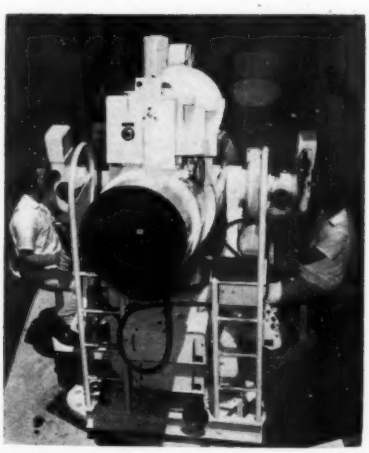
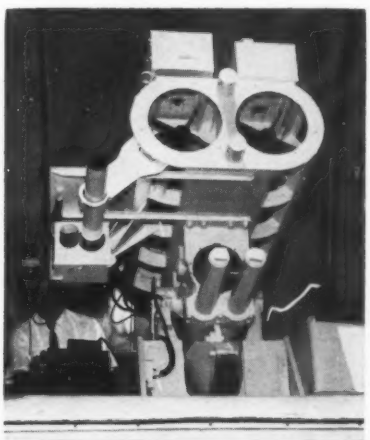


IGOR shares its long-range tracking with ROTI, has 30 to 120-in. lenses.

ROTI is highly accurate long-range tracking and photographic instrument.



SANDIA telescope, like all Metric Optics gear, tracks and photographs.

PHOTOGRAPHY AT
CAPE CANAVERAL

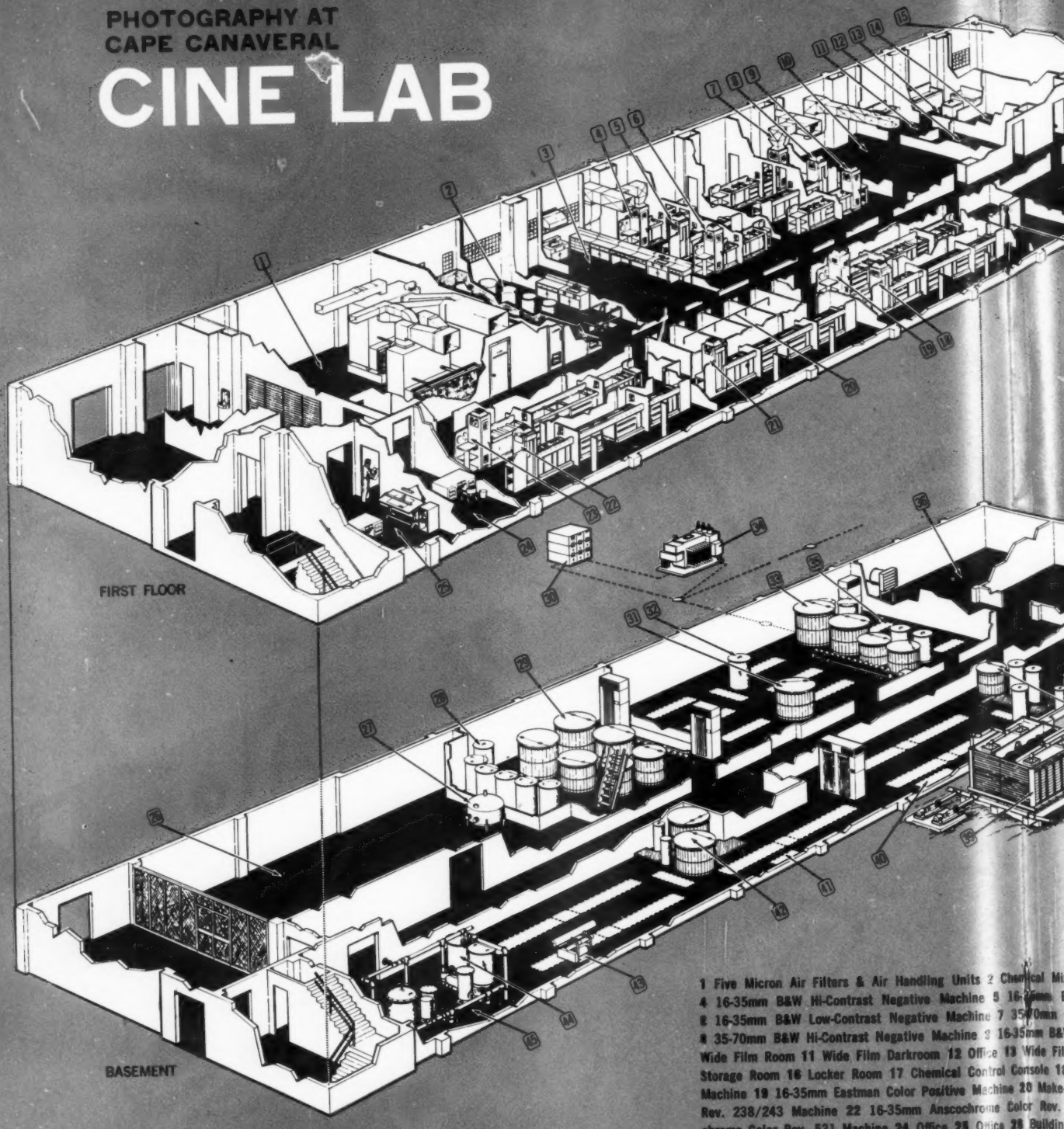
PORTFOLIO

Photography is not always expressive enough to depict its subject adequately and truthfully. Too often, the picture is as literal as a catalog listing. However, these pictures made by RCA photographers at Cape Canaveral are superb exceptions to this very depressing situation. They manage to capture the exciting uncertainty of the space age. Flight by rocket is an adventure dreamed of by poets and accomplished by scientists. These pictures show man as

he tends his cranky infant, wondering what the first words will be. Sometimes the answer is a triumphant roar as the missile streaks skyward. Sometimes it is a frustrating bellow of pain as it blows up on the pad. Both answers are important. The successes encourage, the failures instruct. And always, man tries until he succeeds in ushering in a new era, the age of space. Here it is, being born.

PHOTOGRAPHY AT
CAPE CANAVERAL

CINE LAB



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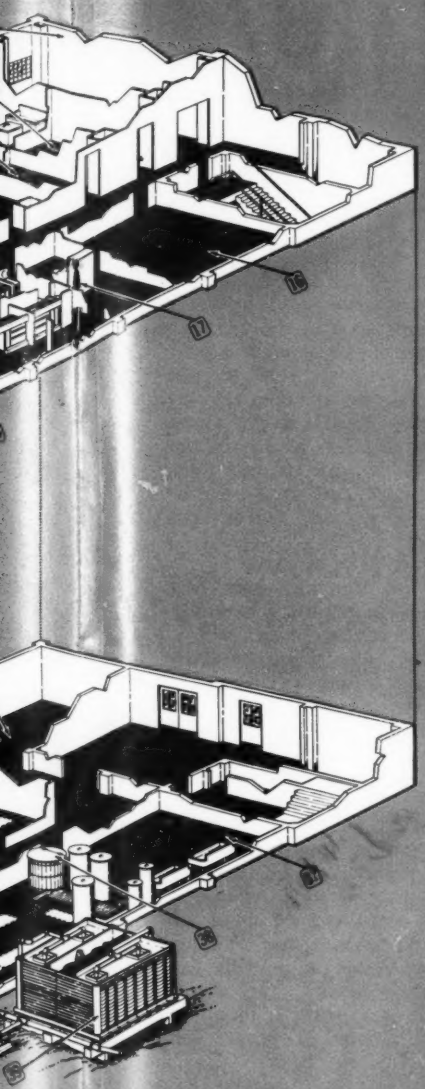

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Control Console 18 16-35mm Eastman Color Negative
Machine 20 Make-up Dark Rooms 21 35-70mm Ansco
chrome Color Rev. 531 Machine 23 35-70mm Ansco-
Office 28 Building Utility Area 27 500-Gal. Deminer-
Replenish Tanks 29 Color Chemical Recirculation Tanks
Chilled Water Storage Tank 32 B&W Stop Replenish
Area 34 750 KVA Transformer 35 Solution Tempera-
37 Maintenance Shop 38 Color Replenish & Recircu-
ling Tower 40 15-Ton Wash Water Chiller 41 7½-Ton
er Replenish Tanks 43 15-Ton Wash Water Chiller 44
Water Filtration Area

Cinematography is a big business at Cape Canaveral, and all the miles of missile footage which record America's space efforts in the South Atlantic funnel through this elaborately equipped and expertly run motion picture laboratory, which has established a reputation for maximum quality while fighting time and environment

The manager of Photographic Processing at the Atlantic Missile Range is enthroned in a hot seat. He works for the RCA Service Company but he answers to the Air Force, the missile contractors and subcontractors who bring their precious brainchildren to Cape Canaveral for testing, the data processors and RCA's own photographers who are forced to trust to the lab for their finished products and therefore their professional reputations.

This is only part of the squeeze that can raise the temperature in Gaver M. Power's air conditioned office in the Technical Laboratory Building at Patrick Air Force Base. The volume is not inconsequential; about $60,000 worth of original missile footage pass through the hands of Powers' staff. The spoilage in processing must be near zero, because spoiled footage may mean the waste of a test, the cost of which makes that film bill look like peanuts. Likewise there is time pressure. A lag in the delivery of news footage or prints can eliminate their value, and delays in the delivery of technical footage can delay America's space technology.

Powers is not a photographer. He is an electrical engineer by training and an administrator by trade. His main function is delegating responsibility to photographic technicians, whose training and experience are formidable. The main divisions under Powers are a cine lab and a still lab *(see page 50)*.

Wallace F. Bischof, an RCA Service Co. chemical engineer who has since moved from the Cape to conquer new worlds, explained the technical aims of the cine lab. "We want the photographer to regard all the processing we do—Eastman Color Negative, Anscochrome and Super Anscochrome and black-and-white film—the same way the public regards the processing of Kodachrome." That is, the processing achieves the very best results possible with the material, and it is immutable. The photographer can't second guess his exposures with fudge factors in the processing; if anything's awry it falls on the shoulders of the photographer or the camera. He'd better make sure his camera operates properly and his exposures are right.

Likewise the customers—the Air Force and the range users—must be convinced by good deeds that the processing in the lab is at least almost perfect: all the footage shot by range photography and metric optics funnels through the cine lab. The Air Force has established this monopoly in the interest of economy and secrecy. It keeps tabs on the costs, and it has a good idea of the charges for processing.

The means to these ends are good equipment and good people. RCA stints on neither.

The cine lab, now approaching its second anniversary, was designed, manufactured and installed by the Houston Fearless Corp. according to specifications set up by the Air Force on plans made by the RCA staff.

There are five color processing machines. One of the 16/35mm handles the Eastman Color Negative (5248), the Eastman Color Intermediate (5253) and Eastman

Color Internegative (5382) film. A second machine processes Eastman Color Print film (5382). The latter is the documentary footage delivered to the government and the range users. Original footage stays at Patrick Air Force Base. Solutions common to both processes are recirculated to their respective replenishment, filtration and temperature control tanks.

A similar set-up is used for the engineering films, which are shot and duplicated on Ansco emulsions. One 16/35mm machine processes Ansco Duplicating Color Reversal films (Type 238-538) and one each of the 16/35 and 35/70 units handles Anscochrome films (Types 525 and 531).

There are six black-and-white machines. Four handle high contrast tracking films in sizes from 16mm to 70mm. One is used for normal contrast 16 or 35mm film and one machine takes 16 or 35mm print films.

Using engineering techniques, Powers and his staff have analyzed the production potential of these machines as well as the duplicating operations. A schedule for maximum production hangs on the wall of the production manager, Jim Stuart, Sr. Ironically, if he is snowed with work, Stuart has an easy time of it. He simply makes sure that his wall chart schedule is lived up to and he is sure that all footage shot at the Cape will go through in three days and that he can guarantee delivery in five days considering make-overs of prints or dupes. When things are slow, he adds some grey hairs solving the question, how can he slice a few hours or days off the schedule.

One of the biggest production hurdles is the fact that there is a great deal of color duplicating work. Unlike the average commercial installation, however, only a relatively few duplicates of each master is made. On a certain sequence only a missile contractor and one subcontractor may be interested in the film. Yet they rightfully expect regular commercial quality in their film. Now if instead a hundred or a thousand prints of this footage were required, the time and cost of a few test prints would be insignificant in terms of the total order. This is anything but the case when only a few duplicates are involved.

The cine lab manages to slip through the horns of this dilemma with a recent, impressive, and expensive device. It is a Hazeltine Color Analyzer. It is a well-instrumented closed circuit color television system. The operator sits at a console about 10 ft. from the screen. He threads color negative camera film into the console, presses a switch and sees a positive color image on the screen. Independent controls for each of the three photographic primaries are at his fingertips. The operator adjusts the image for the best color balance, reads his dial settings and moves onto the next scene.

Later, the dial settings are translated into holes on a paper tape which regulates the balance of the light source in the printers.

The results of the system are impressive. Spoilage of second and third generation film from all causes including such as scratches and film breaks as well as improper color balance and exposure error hovers around 5 per cent (processing spoilage of original film is practically nil). The analyzer has repaid its costs in saved film, not to mention labor and delivery time.

Equipment such as this provides the capacity to turn out the large volume of processing within the short time permitted. It is also the base for the high quality standards of the cine lab. But machines, however automatic, do not automatically turn out high quality work. Procedures and skill are just as essential.

The production workers in the cine lab are, for the most part, highly skilled veterans of commercial and entertainment production. As indicated, the requirements at a missile test center are somewhat different from those of Hollywood, but pictures are pictures.

Large scale processing takes tons of water. The water at Patrick Air Force base is anything but ideal for processing. Bischof says it contains tremendous quantities of undissolved solids up to, and occasionally over, ⅛ in. in diameter. The most menacing of these undissolved particles is sand. Furthermore, the water is usually too darned hot, varying from 72 to 84F, while processing with all solutions is carried out at 70F.

Moviola absorbs attention of Gaver M. Powers *(standing)*, Anton Ponyetsky and W. T. White, Sr., in cutting room.

Chart tells production manager J. T. Stuart, Sr., how to get maximum output with full load, signals bottlenecks.

Therefore all the incoming water is chilled and filtered. The main filter is charged with diatomaceous earth. It can be back flushed and recharged. There are two cartridge filters as well, but they clog with debris too quickly and are used as standby only. Particles larger than five microns (.005mm) are removed by this filtering action. Water used for mixing chemical solutions is de-ionized as well.

A single water-cooler tower serves both to chill the water, provide air conditioning and operate the chillers which keep the processing solutions at temperature 70F plus or minus ¼ degree.

Like the water, the air in the processing laboratory is carefully controlled. Temperature is 70F with zone control. Relative humidity is 40 per cent. Filtration removes air particles larger than five microns, helping solve the dust problem.

Numerous recording thermometers are strategically placed throughout the lab, but the most impressive temperature control device is a console which displays and automatically records the temperatures of all the processing solutions. A telephone is nearby.

Riding herd on the chemical and sensitometric control of all the cine and black-and-white processing is Bill Weist and his staff of 14 persons, most of them college trained. Before a process is started a sense strip and a scratch test is sent through the machine. Processing does not begin until the machine and its solutions get the go ahead from chemical control. Other sense strips are fed through the machines every 1000 ft. or so, all are measured and recorded in a fat book of H&D curves. In their well equipped laboratory, Weist's chemists perform a chemical analysis of all film processing solutions at least every 24 hours and all print processing solutions at least every 36 hours. Meantimes, pH is checked every 4 hours, and wash water analyzed at random intervals.

This work has been effective. Processing solutions are kept through replenishment and silver recovery almost indefinitely. None of the processes have ever been out of the tight control limits. And not so much as a foot of exposed film has been lost for solution content or temperature being out of bounds. In this business, you have to be right.—THE END

TV-color slide comparison calibrates Hazeltine unit

A DREAM MONEY BUYS

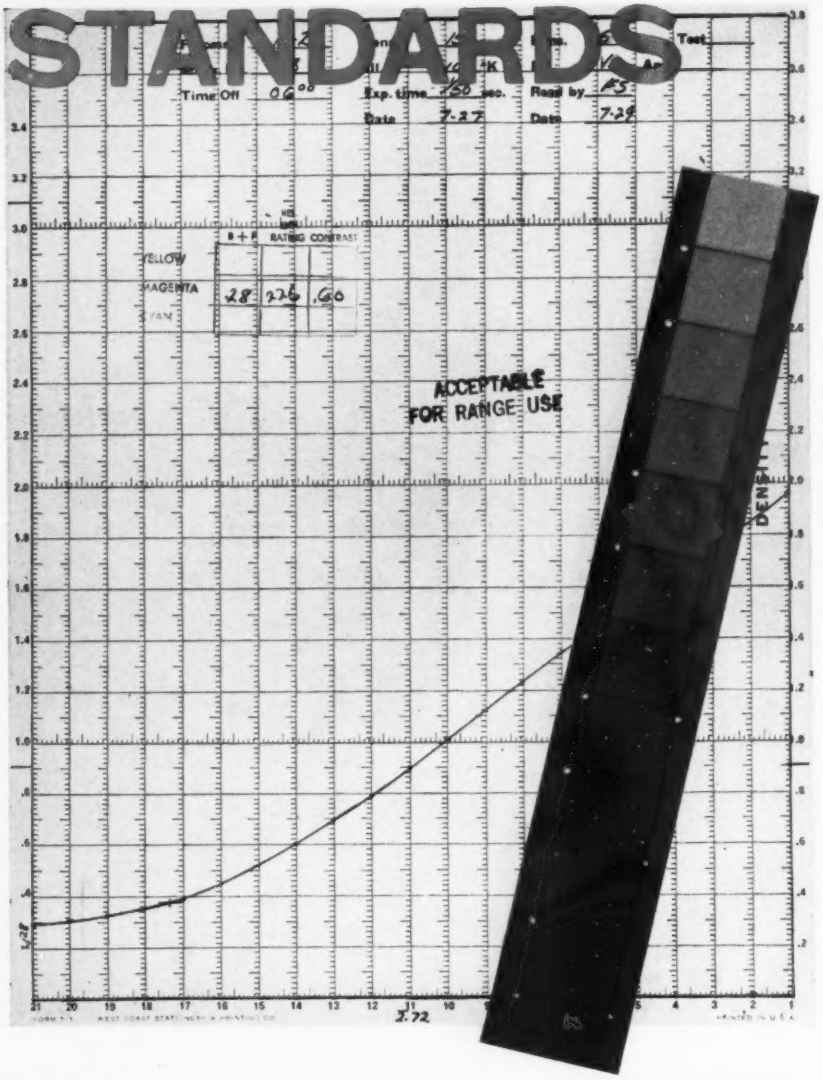
Bill Cooper punches tape which . . .

Ned Landis feeds to color printer

The printing department of the Cine Lab was caught in a squeeze. It prepares transparency positives from the original color negative footage. The transparency positives must be good because they serve as the masters for the customers—the missile contractors and subcontractors. Furthermore, this is short run work, yet the Air Force wants it handled quickly and inexpensively. This makes trial prints impractical. Science comes to the rescue with the Hazeltine Color Analyzer. It is a color television system which scans a single frame film negative and reproduces it as a color positive on the screen. By adjusting the electronic circuit, the operator is able to vary the color balance of the screen image until it is optimum. Calibrations on the analyzer interpret these adjustments in terms of the color balance of the motion picture printer. The operator reads these calibrations and codes them on a paper tape which is used to continually adjust the color balance of the printer light source. The dream machine pays for itself

PHOTOGRAPHY AT CAPE CANAVERAL

STANDARDS



Scientific investigations underlie the choices of the photographic materials and techniques at the Atlantic Missile Range. Chief investigator is the Photographic Standard Department. Their tools: sensitometer, densitometer, spectrograph and inquiring minds

De-garbaging Manager Starbird

Specialists D. A. Odell and E. A. Turner

When a darkroom technician at Cape Canaveral sets his timer for a batch of 4 x 5 negatives, he does so not according to his own judgment, nor the manufacturer's, nor the photographer's, nor his bosses'. Instead he rigidly follows the rule laid down by Photographic Standards, a group whose word is taken to be infallible in matters of photographic materials and technique at Cape Canaveral.

Photographic Standards is not only unique in itself, it makes the photographic laboratory of the Atlantic Missile Range unique amongst in-company photographic departments. In the words of Supervisor A. H. Starbird, its job is to take the "opinionated garbage" out of the application of photography and substitute empirically established fact. It takes no direct part in the shooting or processing of pictures; it's purely a staff function. But it has its hand in every aspect of photography at the Atlantic Missile Range, Range and Metric Optics, and it reports directly to the manager of Photographic Processing, Gaver M. Powers.

A hypothetical example shows Standards' role in slicing through woolly notions to get to the realities of the case. A roll of 70mm film, enough, say, to keep you in cigarettes for a year, is flown down to Ascension Island for some recovery footage. The film is loaded. The test is postponed. The film is unloaded. A couple of hurricanes and heatwaves later, the test is canceled. But it looks like another test is shaping up. This film goes back into the magazine. Then the cov-

erage is canceled, and the film returned to Patrick Air Force Base. Is it or isn't it up to snuff?

Standards is well equipped to supply the answer. It runs a sensitometric test of the film to determine not only the speed of the film but its fog level, spectral sensitivity and contrast characteristics. (*See chart and test strip.*) Any degradation can be checked against the original records for this particular batch of film. Furthermore, Standards is equipped to measure almost any other aspect of the film, including acutance, resolution, the spacing of the sprocket holes and even emulsion hardness.

In short, Standards either gives it a clean bill of health or rejects it as faulty. Either way the taxpayer wins. An expensive roll of film is saved from destruction, or a spoiled roll is prevented from impairing the results of a nearly priceless missile test.

Standards' job goes even deeper than this. It must establish procedure to decide when to run such a film through its gauntlet, to establish the definitive standards for storage conditions and to establish procedures for the handling of film in transit or storage.

Tech. F. Sheffield checks sprocketing

In general, the work of the nine-person Standards staff is to inspect all incoming sensitized material, to evaluate new sensitized products and processing chemicals, to investigate systems, and to design photographic systems and procedures for specific needs.

The adoption of a new system such as new cine film would be an executive decision, not up to Standards. The ultimate arbiter would be the Air Force, but Standards would furnish the facts and figures. What new processing equipment will be required to handle the new system? Will there be new requirements for storage tanks, water supply, instruments? How much will it cost?

If approved, Standards designs the photographic aspects of the

Cool minds give film storage once over

system. This would probably include the designation of film speed, processing times and temperatures, processing limits such as fog, maximum and minimum density, color balance, limits for concentrations of chemical ingredients, chemical life, ad infinitum.

And finally, as with all other sensitized products, Standards would evaluate samples of every emulsion number of the film.

The basic philosophy behind the work of the Standards group is to simplify getting the highest practical quality by setting benchmarks which everyone can follow, by streamlining the technical processes and by instituting order to drive out confusion.

The final conclusions of this philosophy might puzzle a photographer. Getting back to the timing of black-and-white sheet film development: all the sheet and filmpack camera films are developed in a single developer for exactly the same length of time, regardless of their speed or manufacture. This sounds like a sacrifice of quality to accommodation, but actually it is not. Standards' careful tests have shown that the sheet and filmpack films used at the Cape, processed in DK-50 1:1 for a given length of time, have an amazingly similar useful development contrast. Now beyond a certain density —that represented by a white or near-white area in the subject—the films vary much more than in their *useful* contrast range. These statements might not hold true if the film were not slightly underdeveloped, but because of the brilliant subject contrast in most of the scenes made at the Cape, contrast must be held down through shorter development. For the range of exposure set for the tests (Log_{10} E 1.30) the development contrast measured from .1 plus base and fog is .62 to .65.

The consistency held in the development is unusual, particularly considering that it is so standard. A standard developer is used, it is replenished by volume. Timing and loading is manual, and the 3½-gal. tank used is standard throughout the industry. Yet by repeated actual test, development is consistent within 1/6 of a stop for speed and .05 density for contrast.

The "repeated actual test" used to determine consistency is commonly known, but rarely used—except at Cape Canaveral. Standards prepares a set of precisely exposed test strips (using their sensitometer) and gives them to the darkroom technician. Every time he develops a batch of film, he develops one of these sense strips along with it. This is true whether the tank is loaded to capacity or but a single

(*continued on page* 72)

J. Stuart and Tech. Writer J. G. Moore

PHOTOGRAPHY AT CAPE CANAVERAL

Strict adherence to a high standard of quality characterizes the work of the AMR Still Processing Lab. From quality control inspection, to portraits, to work scheduling, a carefully drawn SOP puts a premium on order and excellence. Next step: volume black-and-white and color printing

Still Processing at the Atlantic Missile Range is in a state of transition. Until recently, it was a large but conventional in-organization photo lab. It is rapidly headed toward becoming one of the most versatile and technically advanced photo facilities in the country. It expects to take two giant steps forward with roll processing for black-and-white prints and almost complete conversion to negative-positive for color work at Cape Canaveral.

The manager of Still Processing is R. M. Kise, who reports to G. M. Powers, manager of the entire Photo Lab, who answers to the management of the RCA Service Company, who speak to the prime contractor of the Atlantic Missile Range, Pan American and the Air Force. The Air Force holds Kise's group responsible for quality, low-cost production of any still photograph required in the operation of Cape Canaveral. Still Processing develops the sheet, roll, 35mm still and aerial film shot by Range Photography. It makes photographs for the Tech Lab, via one photographer who specializes in portrait and commercial work. It processes the ballistic camera plates, makes process negatives and positives, dupes transparencies, makes dupe negatives and Ektacolor prints.

Old plot, new actors

As with most any lab in the country, however, the bulk of the work consists of making 8 x 10

Automatic Homrich printer whacks out dupes in the slide department.

glossy black-and-white prints, and it was decided that investing study, planning and equipment in this would yield the greatest returns for the time and money invested.

Tight little tank

The first step was to administer tight control of black-and-white film processing variables. Actually black-and-white processing is not a production problem. One man handles all the work with a single set of 3½-gal. tanks. The point was that starting out with a properly developed negative is half the battle in print production. Photographic Standards (*see page 48*) was called in to make a study. As a result of this study, some changes were made in the equipment, notably a change in the solenoid valve to make gaseous burst agitation more consistent, and the institution of a few new procedures. Now a sensitometric strip accompanies each batch of film which goes through the 3½-gal. tank. This is read on a densitometer by Chemical Control and the readings charted. With the equipment and procedures developed by Photographic Standards, the darkroom technician is expected to keep processing within 1/6 stop for speed and within .05 density for contrast variation from standard. The sense strip records show that he does, with certainty.

A more familiar system is used to guarantee consistency with 35mm and 120 processing. These are developed in full strength Microdol-X developer, which is used once and then thrown away. The technician uses Nikor reels and tanks, agitating every 30 sec. Processing temperature is 70°F and the following development times are used: Verichrome Pan and Tri-X Pan, 10 min.; Plus-X Pan and Panatomic-X, 7 min. These development times are slightly less than those recommended by the manufacturer, but the standard was designed to help handle the high brightness ratio of the brilliantly lighted scenes in the semi-tropical Canaveral sun.

The long, costly wait

Black-and-white film development buttoned down, Still Processing and the Standards Group turned their attention to print exposure. A careful study revealed that the problem here is not much different from the problem elsewhere. Unless he's doing a long run, a printer spends most of his time waiting for prints to "come up" in the developer—to make sure that the exposure was proper—before going on to the next negative. The study indicated that up-to-date equipment was required to break this bottleneck.

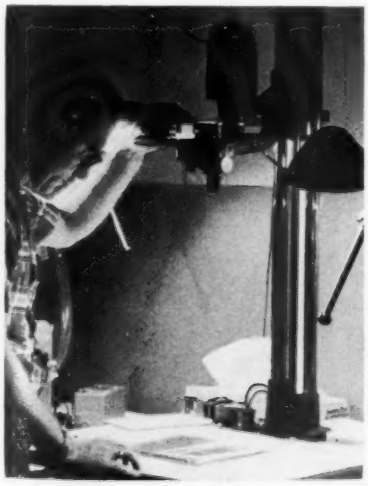
Now, besides his enlarger (Beseler, Omega and Durst units are used), each printer has the following: A Simmons Omega variable contrast timer, a constant voltage regulator, a Kodak static control unit and a Densichron Model II.

Standards and Still Processing technicians worked out the calibrations for the Densichrons; each unit, enlarger and printing meter, was calibrated individually.

Four easy steps

In order to keep the variables affecting photographic exposure to a minimum, it was decided to hold exposure time and lamp voltage constant, and to compensate for magnification and negative variables by adjusting the aperture of the lens and the ratio of hard to soft printing filters. Ideally—through the use of the variable contrast timer, lens adjustment and hand dodging—each print would receive identical exposure.

In practice, the printer inserts his negative, focuses it and places his easel probe under the brightest portion of the image. He then adjusts the lens aperture so that the Densichron needle points to zero density. At this juncture he moves the probe to the darkest significant portion of the image. The needle on the Densichron jumps to the left and settles in one of four contrast ranges marked on the glass of the dial. These ranges correspond to settings on the variable contrast timer. The printer then presses one of the calibration buttons on the Densichron. This sets the sensitivity of the unit to correspond to the sensitivity of the paper, *when*



Copies of art and prints are made with a standard Reprovit unit and TLC.

Biggest of the cameras employed by the still lab is this Robertson operated by Ida Wagoner who handles the line and continuous tone copies.

filtered to the indicated contrast range. Now the printer makes his highlight, exposure-determining adjustment. The face of the meter glass is inscribed with three lines. One represents a bright highlight, e.g. a white shirt. The second represents a middle highlight, such as Canaveral concrete. The third a dark highlight, grass for example. Depending on which type of highlight is present in his picture, the printer adjusts his aperture until the needle reaches the appropriate marking on the dial.

Finally he adjusts the variable contrast timer to correspond to the density range he has determined for the negative, and presses the button to commence the exposure.

This calibration was worked out with extensive testing, using both grey scales and typical negatives. One of the conclusions of the tests was that so little as 1/6 stop made a difference in the quality of a print. Therefore the system has to call the exposures pretty close.

End of the circle

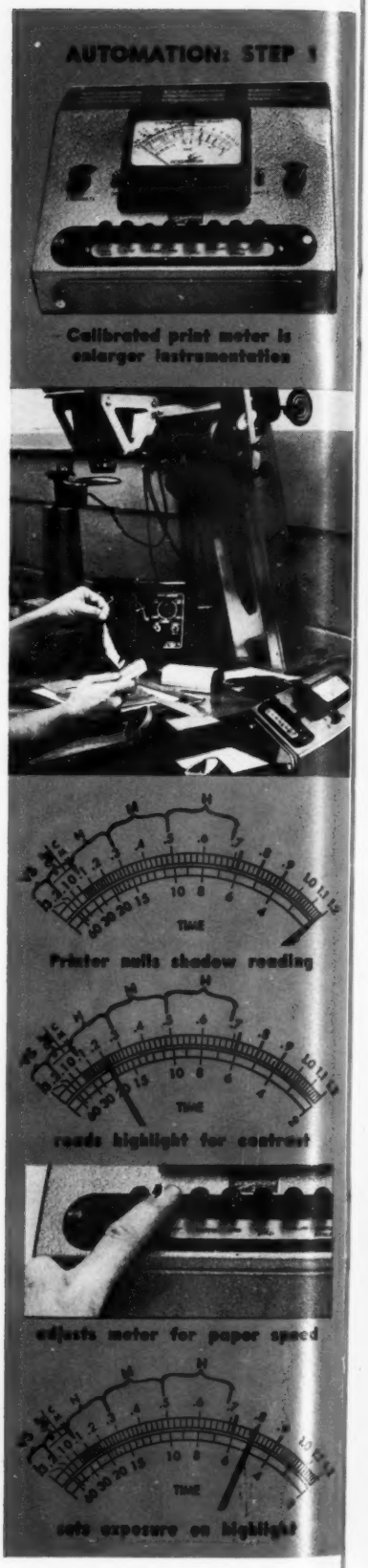
The printers are well satisfied with the results. Finding the proper contrast grade and the print exposure based on highlight density nearly puts an end to misfires, and to the vicious circle of unnecessary dodging. The most significant change, however, is that the printer can expose a number of prints from a number of varied negatives without interrupting his work to develop a print. Print quality and print production have gone up sharply, while rejects and waste have dropped way down.

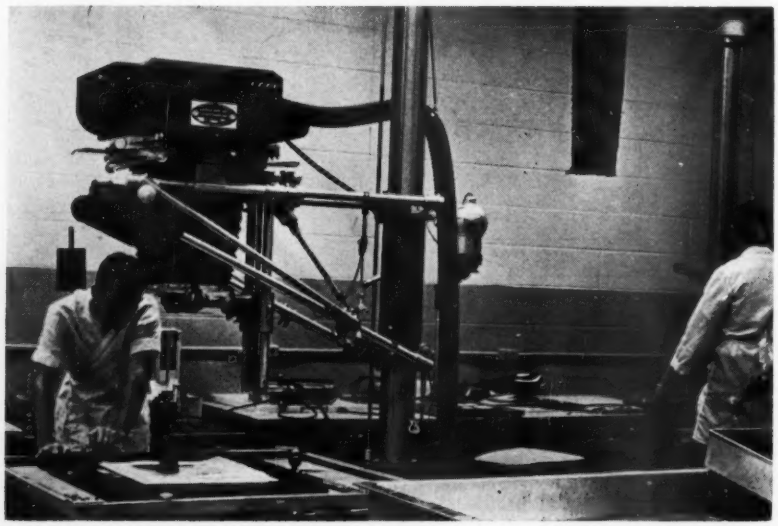
Now the lab is preparing for the next step. Each of the printers will be equipped with a roll paper easel. Following this a roll paper processor will be installed to take over the developing and processing, which at this point follows an unvarying routine.

Ektacolor print exposure and processing is handled according to a similar routine. But anticipating a greater demand for color prints, the lab expects to have an intensive study made of this procedure in order to step up an already high level of output and production.

System

This scientific approach is reflected in many aspects of the lab. For example, a timing device is attached to the enlargers used for color printing. It logs the number of hours the enlarger lamp is used. At a given number, set by photometric tests of the lamps, the lamp is replaced with one which has been "burned in"—burned a specified length of time to stabilize its characteristics. When duplicate negatives are made, the technician measures the original for highlight density and density range. He then consults a chart prepared in advance which specifies printing


AUTOMATION: STEP 1
Calibrated print meter is enlarger instrumentation
Printer nulls shadow reading
reads highlight for contrast
adjusts meter for paper speed
sets exposure on highlight



Specialty enlarging is done with two Saltzman enlargers and massive print trays. Although bulk of work is 8 x 10 from 4 x 5, lab must handle any work.

Color printing has similar instrumentation, standards will be even finer

Recording thermometer in color lab is *semper fidelis* guard of quality

Even captioning is geared up, via this spirit duplicating department

and development times. Every emulsion number of print paper is checked for speed, contrast, and in the case of color materials, color balance. Regular tests are made with Ektacolor paper comparing a grey scale exposed with a sensitometer and exposed with the enlarger source. Purpose: to pinpoint variations in the enlarging illumination. In short, the lab is attempting one by one to eliminate the multifarious variables which affect the final photographic product.

More to it than photography

In Still Processing, there are two key jobs outside of the actual production. One of them is scheduling. One man devotes his energies to checking every incoming work order, deciding on the basis of priorities which work will be done first, making sure that the jobs are handled, making sure that the work order is explicit and complete and typing a caption for new negatives. He checks finished work for compliance with the work order.

Another is the quality control man. He checks all negatives to make sure they were properly processed and that they are printable. Before any finished work is sent out, he checks the negative against the print to make certain it is up to the lab's high standards.

Specialties a specialty

One somewhat unusual service in Still Processing is spirit duplication. The Air Force requires a complete identification on the back of each photograph along with its secrecy status. Still Processing has settled on spirit duplication as the means to this end, although it involves time and some spoilage. This caption material is prepared from the negative before it goes into printing. The spirit master is trimmed to fit in the kraft envelope. Once the prints are dried and straightened, a technician runs them through the spirit duplicator, then returns the spirit master to the envelope. If the negative is reordered, the master is used again.

Aside from the monochrome and color processing, there are three other departments within Still Processing. One is a still photographic studio, manned by one photographer. He makes portraits, technical illustrations, some copies, even passport pictures. Another is a graphic arts unit, equipped with a Robertson camera, arc lamps and its own darkroom. The third unit comprises slide duplicating and slide making. It is equipped with a Homrich slide copying machine, a Reprovit with appropriate Leica equipment, a film cutting machine, a slide mounting press and two home-grown units for making enlarged and reduced slide duplicates. Both of them use enlarger parts for illumination sources and one is equipped with an Exakta camera, while the other is hooked up to a Speed Graphic. With this pair, the Still Processing technician can dupe a 4 x 5 transparency, go from 4 x 5 to 35mm or back again. Dupes from 35mm are handled with the high-speed Homrich unit.

Because a missile may go up at any time, the lab runs on a two shift basis. News material is handled on a rush basis, but no compromise with prescribed technical procedure is ever made.

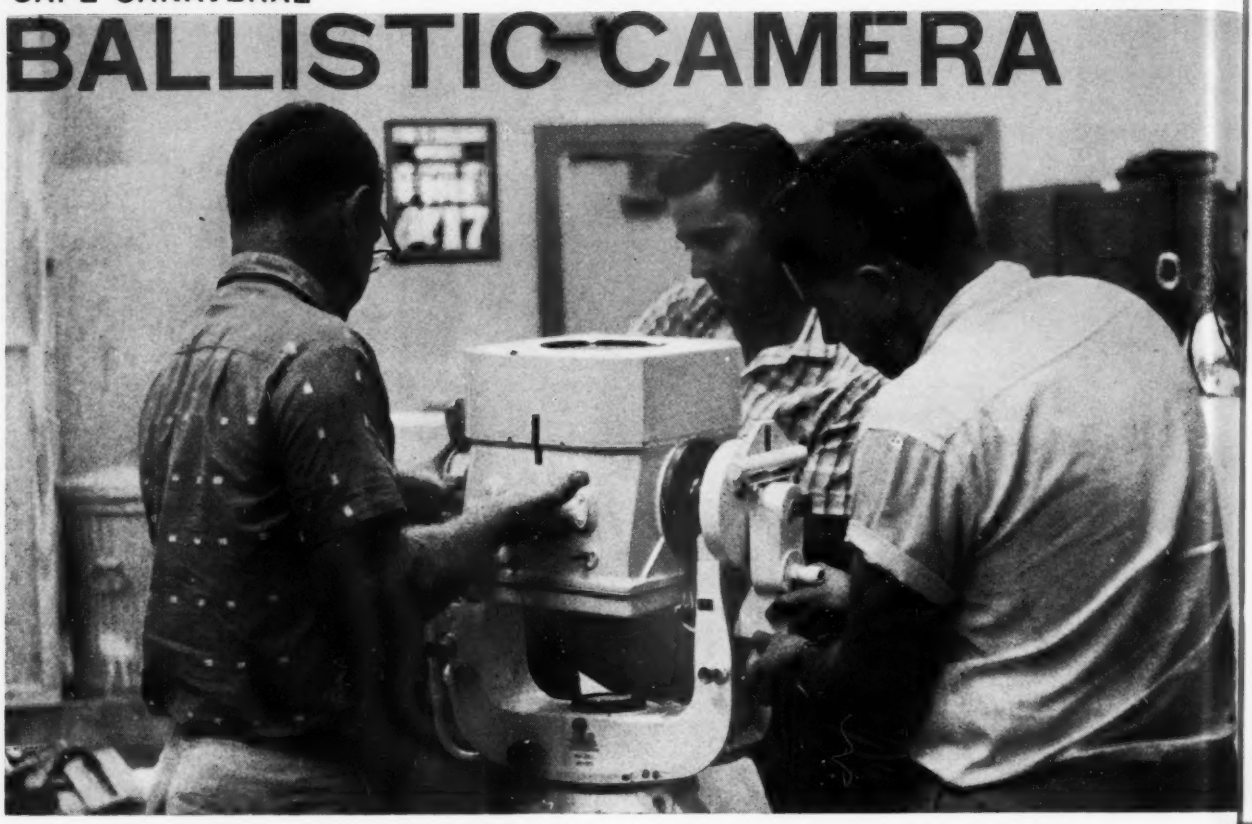
Thrashing it out

A recent innovation in the department is the staff meeting. The workers in Still Processing are collected for a session to air gripes and iron out difficulties. On the agenda of this meeting are discussions of new procedures, such as the roll processing equipment, standards and innovations. The meeting also gives supervisors and the quality control man an opportunity to discuss print quality, cropping and other matters of taste so important to the quality of a photograph.

The technicians in the still lab are organized by the IATSE, the union which represents technical and trade employees in the motion picture industry. They are recruited from a number of backgrounds ranging from camera stores to photographic schools. Generally a new employee starts as a print finisher, but is given opportunity to learn the Still Processing procedures in developing, printing and duplicating. For the most part, they are anxious to do so. Generally they welcome the high standards of the lab, and are proud of their craft. What more could one ask?—END

PHOTOGRAPHY AT
CAPE CANAVERAL

BALLISTIC CAMERA



Best of the best, data obtained from ballistic camera plates are 99.999 per cent accurate, making it tool of Range Instrumentation Calibration

The *wunderkind* of photographic instrumentation at Cape Canaveral is the ballistic camera. The precision of its measurements almost defies belief. With cameras spread out a hundred or so miles apart, and spaced from 200 to 350 miles from the trajectory, the ballistic camera system is able to locate the position of a missile from Cape Canaveral to an absolute accuracy of twenty feet.

This uncanny exactitude is the result of the precision of the camera, the subtlety of the scientists who plan the deployment and utilization of the cameras, and good technique and sensibility of the men who operate the cameras. The 28 field personnel who operate the ballistic cameras are in the charge of A. E. Glei, manager of Range Instrumentation Calibration. This Range Instrumentation Calibration is part of the RCA Service Company which runs most of the photographic facilities at the Atlantic Missile Range. But it is independent of the other photographic units, and reports to Instrumentation Control. It is in a class by itself in other ways than organizational ones. The data it collects is unquestionably the most precise of any, photographic or electronic. It is therefore used to correct the results of the other systems, optical and electronic.

Cape Canaveral was not the first place to see this device in action. The camera was produced to the specifications of a group of scientists at the Aberdeen Proving Ground to support the work of the Army Ballistic Missile Agency. The basic parts are a modified RC-5 aerial camera and a T-4 astronomical theodolite which acts as a base for the camera. The unit is manufactured by a firm of Swiss instrument makers, Wild of Heerburg.

Unlike most of the missile tracking cameras, it is essentially a wide-angle unit. It tracks only in the sense that its coverage is wide enough to include a substantial portion of the trajectory; it is stationary during operation. The lenses used are a 115mm Aviogon, a 210mm Aviotar and a 300mm Astrotar, while the plate size is 190 x 210mm (7¾ x 8¼ in.).

The plates used are ¼-in. optically flat glass (flat within six fringes), produced on special order by the Eastman Kodak Co. at $10 per.

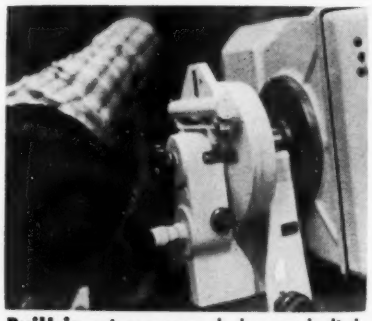
The cameras, as we've hinted, are made to close tolerances, and the lenses are calibrated for accuracy by shooting the night sky. The amount they displace a star

(*continued on page* 68)

Unvarying set-up procedure begins with check of the long spirit level.

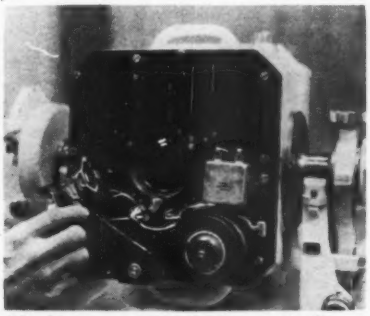
Magnifiers help zero in alignment back with four points on camera body.

Aerial image of North Star is sighted for azimuth, elevation reference.

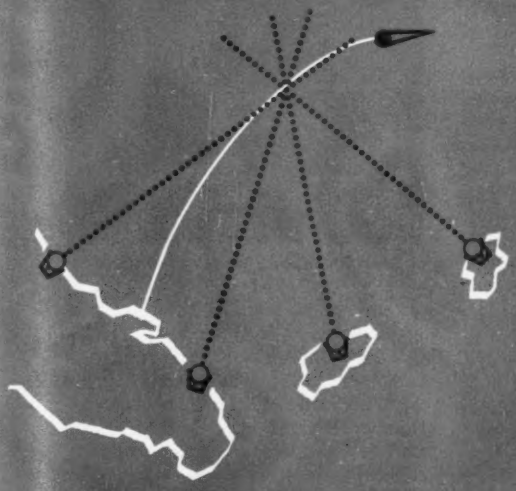


Built-in microscopes help read dials on both axes as camera is "aimed."

Plate holder replaces the alignment back. Camera is no longer touched.



Shutter, operated electronically, is shown exposed in this demonstration.



Stars and triangles are essentials in ballistic camera instrumentation. First order survey between camera stations sets length, while azimuth and elevation measurements—based on distance between missile image and star points—set two angles of each triangle. Picture is print from atypical plate: shows Sputnik and Milky Way.

PHOTOGRAPHY AT CAPE CANAVERAL

REPRODUCTION NOT

Jimmy Ward and Gloria Conegan run XeroX camera in tandem

Reproduction at Cape Canaveral is often the last step in a chain of data collection and recording that merely begins when a missile takes off for its quick long flight. Pan Am handles over a million reproductions monthly in this twelve-man shop

Ward stripping a film negative

As a test center, the only tangible product of the Atlantic Missile Range is information in the form of pictures, charts, computer tapes and words. While the Range may make or break a missile program, the missiles themselves are dreamed up and constructed elsewhere.

Dealing as they do in data, the space scientists at Cape Canaveral make use of almost every means known to 20th-century man for dishing out paper work. Photomechanical reproduction is no exception. Actually there are two reproduction establishments within the AMR. One is a Class A Air Force printing shop. It is not treated here because its work is not limited to the testing of missiles; instead, it serves a number of Air Force installations in the Florida area, including the Atlantic Missile Range. The other installation is in the bowels of the Technical Laboratory. It is designed to produce short runs of documents at a furious pace for the space thinkers, work that the Air Force unit is a little too high-geared to handle.

Like all the Cape Canaveral units, this Tech Lab reproduction department is also part of the Air Force. Pan American World Airways, Guided Missiles Range Division, operates this facility as part of their job as prime contractors for the Atlantic Missile Range. Most

Gloria Conegan burns in the plate

of the photographic facilities are subcontracted by Pan Am to RCA, but this unit is not. It is regarded as a service facility, and like the quality control men, transportation workers, linemen, construction crews, bakers and what have you, the reproduction workers pay allegiance to the Air Force through Pan Am.

This arrangement has some odd aspects. For example, a directive emanating from the Joint Congressional Committee on Printing prohibits shops of this class from being equipped with power machinery such as paper trimmers. Being that the unit prepares Air Force and civilian-type documents, it has a

number of "standard" paper sizes aside from the ever-present 8½ x 11. In many cases it is not feasible to stock pre-cut sheets. Result: Pan Am had to scour the Southeast to locate a capacious enough cutter powered by Norwegian steam instead of an electric motor. They found a classic Chandler with a 2-yd. lever for operating the blade. Strong-armed Alston Shipes pulls it down as if he were moving a

R. L. Redfern adjusts his Multi

freight car with a crowbar, and at the end of the blow lifts his own weight off the floor as he drives the blade home.

Another complication is secrecy. There's a good deal of paper work involved in handling classified-for-security paper work. As a matter of fact, one of the two clerical employees in the section devotes all of her time to classified materials.

In all, the repro section is a productive, flexible reproduction shop accomplished in handling short runs. A typical job totals 10, 20 or 30 copies. Despite the necessity for frequent press changes, production records showed a total of 1,500,000 litho impressions for a not atypical month. This with five Multis (four 1250s and one 2066) operated by four men.

A large percentage of the production is done with offset masters prepared by secretaries and typists throughout the Tech Lab. (Sometimes these are monster jobs, e.g. solid pages of nonsense random numbers.) But several other means to an offset master are employed. Workhorse is a XeroX camera and sensitizing unit operated by Jimmy Ward and Gloria Conegan. This duo also does stripping of litho negatives and exposure of presensitized plates on a vacuum frame with a diminutive arc lamp. The negatives are prepared elsewhere.

The reproduction department is not the sole source of diazo duplicates in the building. Other equipment, under another department, is located closer to the drafting tables. This leaves plenty of work yet for the two diazo operators in the reproduction department. Mainly it consists of blueline paper copies from translucent originals, but a wide variety of diazo duplicates is offered. The department makes use of colored diazo materials on transparent bases for use as overhead projection slides. Another occasional job is the duplication of charts. These large scale maps are reproduced on black-line Mylar-Base (Tecnifax MYBKLM) and alterations and additions inscribed for specific missile tests. The altered diazo copy serves as the master for sepia diazo duplicates on plasticized paper (Tecnifax 42P), which are used for actual plotting. Final copies are made on blue-line diazo.

Other services offered by the department are paper drilling, spirit duplication and Verifax copying. Occasionally the unit will turn out a two-color report cover, but for the most part the work is limited to same-size single-color work.

Every job that comes into the department is accompanied by a signed work order. (If it isn't, the work is held up until a work order comes through). A priority system is set up. Top priority calls for processing within hours, while bottom priority work may be done within the month. The work orders and the priority system key into

Donald Hobbs drills three round holes

a control system operated with the help of card sorting machines. Supervisors such as Repro's George Emmett know quickly when they're running behind schedule.

The workers in the department —four duplicator operators, two persons on stripping and xerographic camera work, two diazo operators, two persons on spirit duplication, paper drilling and paper cutting and the two clerical workers—are members of the Transport Workers Union, which has something to do with their being employees of Pan Am.

A separate collating room is equipped with Thomas manual and electric collators, an Apeco punch, a General Binding Corp. punch and binder, a Lectrojog paper jobber and two Swingline electric staplers, all run by a group of competent ladies. Many of those million and a half reproductions from the busy duplicators of Emmett's group pass through here before entering the space race.—END

Emma Cox feeds her diazo with TLC

Shipes puts steam on paper cutter

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Ernest E. Reshovsky

PHOTO INSTRUMENTATION

Data reduction at Cape Canaveral; more math than photography

Cape Canaveral, Fla.—The raison d'etre of much of the photography at the Atlantic Missile Range is to learn with mathematical precision the location and position of a rocket or missile at crucial times during its trajectory. The work of the people who operate the cameras that gather this information—the BC-4s, CZRs, ROTIs, IGORs and Cine Theodolites is described elsewhere in this issue. We deal here with the people who insert the mathematical precision, the unsung data reduction specialists who make photo instrumentation a measuring system.

Non-photographic data

This is the work of the RCA Data Reduction Center, which also gets the information from non-photographic sources, mainly radar. Perhaps to oversimplify the case, photography is used to get the facts within 15 miles or so of the earth, while the electronic devices handle the more distant tracking. An exception to this is the ballistic camera, which produces the most precise data, and which serves as the standard against which both photographic and electronic instrumentation is checked.

The schedule of the work of photographic data reduction is deceptively simple. It goes something like this:

From T-time (when the missile is launched) *to T plus 8 or 12 hours*: The cameras take their pictures, the film (and/or plates) is rushed by truck, car or plane to the processing lab from all points in the Atlantic Missile Range and is processed and delivered to data reduction.

T plus 8 or 12 hours: A mathematician views the results and fills in a "preview report" which indicates which films or plates will yield telling data.

T plus 8 or 12 hours to T plus 3 days: Significant portions of the selected photographs are plotted; that is, the distance of the subject left-and-right and up-and-down from a reference point is painstakingly measured. Where the missile is more than a dot on the film, its attitude (which way it points) is also measured. The measurements are recorded with a Flexowriter for consumption by a computer.

T plus 3 days to T plus 12 days: A computer (an IBM 709, soon to be replaced by the fancier 7090) figures back from the measurements of the photographs to calculate the position of the missile in time and space. While doing this it takes a statistical average of conflicting measurements, allows for known errors and estimates the errors of the answers it gives. It furnishes its information in paper and magnetic tape form. The facts are delivered to the Air Force and to the missile contractors.

T plus 12 days: With the completion of an "historical document" containing all the calculated data, explanations, formulae and related material, data reduction has finished the project.

Computers speed processing

The computer is a great boon in this work. The job of refining measurements of the photographs with the appropriate mathematical process, averaging multiple measurements with "least squares" for example, would take months of arithmetic. The computer does it in hours or minutes.

There is talk now of compressing the measurement of the photographs from the present three days to as little as six hours. One approach is the use of automatic reading heads, which are in the works. The operator would roughly locate the point he wished to measure. The machine would locate it precisely and "read out" its location in numbers. Such automatic comparators are well past the design stage and are under development by such firms as Link Instruments and Benson-Lehner.

(*continued on page* 60)

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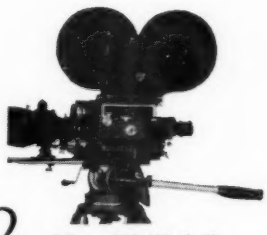
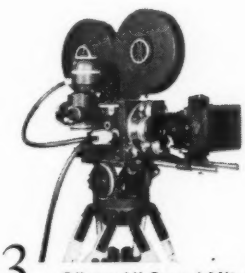
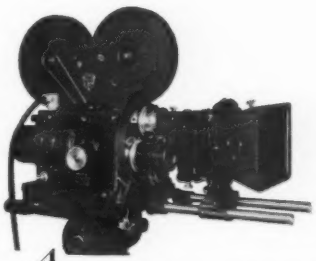


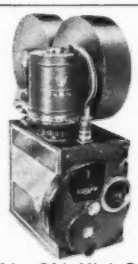
2 35mm NC Mitchell



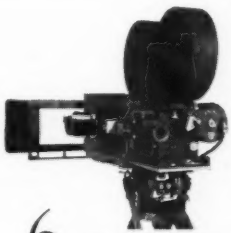
3 35mm Hi-Speed Mitchell



4 16mm Professional Mitchell



5 70mm 2¼ x 2¼ High Speed Mitchell



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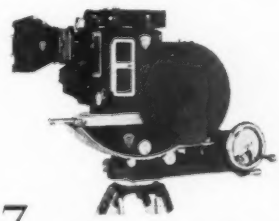

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PHOTO INSTRUMENTATION

(*continued from page* 58)

Duane C. Brown of Mathematical Services in the RCA Data Processing Center said that he envisions even greater speed and accuracy in the future. He sees automatic in-camera development and automatic timing of each frame of exposed film to accelerate photo instrumentation. Brown feels that within five years it will be possible to locate positions on film within 1 micron (1/1000mm) considering all sources of error. The avenue to this sort of accuracy lies in improvements in emulsion stability, more precise comparators and in the accuracy projected for the servo-scanning described above.

The present measuring devices are no slouches, however. BC-4 ballistic plates are read on Wild Stereo Comparators, Mann Comparators and Gaertner Plate Comparators (also called "Big Mike" at AMR). The stereo machine was selected for precision. No stereo plotting is done ordinarily.

CZR film is fed through Coleman Powered Comparators and Gaertner Microscope Comparators ("Little Mike") which are equipped with a "digitized" screw adjustment.

Askania Cine-Theodolite footage goes through a Telecomputer theodolite film reader.

ROTI and IGOR footage is reduced by means of a Richardson viewer equipped with a Coleman attitude attachment (to plot pitch and yaw) and the Gaertner Microscope Comparator which measures roll of the missile by measuring the displacement of a mark on the missile from its vertical axis.

Recently an Aeronca Improved Attitude Reader was installed which will replace the Richardson and Coleman units.

George H. Rosenfield, Photogrammetric Analyst at the RCA Data Processing Center explained some of the theory and practice of his work for the Atlantic Missile Range.

Rosenfield defines analytical photogrammetry as "the science of applying mathematical methods to obtain reliable measurements with photography." And he cites as one of its major advantages the fact that all the basic measurements can be considered independently.

Through "propagation of the measuring error with proper computational techniques," it is possible to come up with answers almost certain to be of extreme accuracy. But just as important in a "mature" measuring system, Rosenfield says, is an indication of the probable inaccuracy of any measurement, the "residual, uncorrected systematic error remaining in the system."

Rosenfield has paid a good deal of attention to all the possible sources of error in the photogrammetric methods. He divides them into random error and systematic error. A marksman deals with something of the same problem. If he consistently shoots to the right and below the bull's eye, he knows he errs systematically and either adjusts his sights or aims to the left and above the bull's eye. If his shots are scattered at random he tries to be more steady, or if he has a live target, he shoots a number of times, knowing that on the average one of his shots will score.

Systematic error

In photogrammetry at the Atlantic Missile Range, there are two groups of systematic error. Rosenfield classifies these into error that is ordinarily corrected in the mathematical reduction and error which is not attenuated by mathematics. Which of the systematic errors can be handled by the computers? Rosenfield lists the first as radial lens distortion (the corners of the film are further from the lens than the center is, and therefore the image is larger at the corners) and atmospheric refraction. These two have the greatest effect on the "photogrammetric model." Fortunately, for the most part they can be calculated. Elaborate reductions are performed to compensate for them.

Rosenfield lists as the second source of systematic, but correctible, error the comparator or reader. At the AMR Data Reduction Center, the very best machines are obtained, and everything is done to adjust, calibrate and maintain them for maximum performance. Chief targets in this effort are "non-perpendicularity of the comparator axes or ways, weave of the ways, periodic errors and secular errors."

Other errors

Other correctible errors are peculiar to certain kinds of photographic data. For example, in cameras employing a focal plane slit as the shutter mechanism, the slit is never at the actual focal plane. For mechanical felicity, there must be a finite distance between the moving slit and the film. With enough brains—human and mechanical—this can be calculated, and canceled out of the answers.

Some of the systematic errors are not attacked with mathematics, but

are indirectly corrected. One such error is the constant measuring error of the comparator operator. Normally this is eliminated by making one set of measurements, then turning the image 180° to make a second set of measurements, and finally averaging the two sets of measurements.

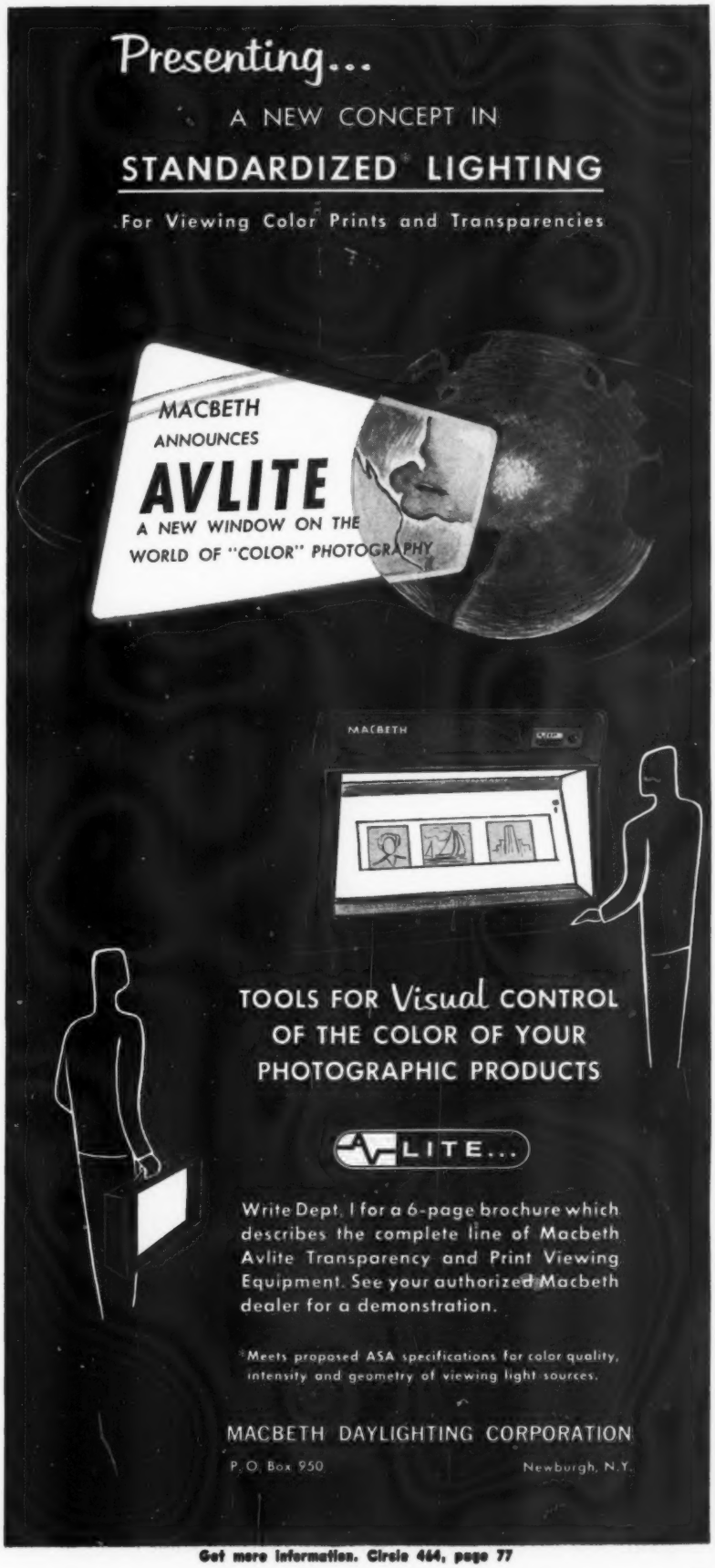
Rosenfield explains that there is another set of errors which are indirectly correctible, scale errors. One example is dimensional change in the film. If the amount of change per unit of length is known, the scale error introduced is corrected.

The second group of systematic errors, in Rosenfield's classification, includes those not normally corrected during data reduction. Instead, every effort is made to prevent them. Rosenfield lists the following examples: ground survey errors in locating camera stations and control points, the photographic plate or film's not being flat, timing error, "identification bias," and any disturbance of the camera between the time it is oriented and the time it records the trajectory of the missile. Preventive measures include establishing suitable facilities for the camera, obtaining suitable instruments, making good photographic exposures, and careful technique.

All by themselves

Rosenfield puts random errors in a class all by themselves. In the most precise aspect of photo instrumentation, the ballistic camera system, the most important random error is the difference in position between the latent image and the developed image, he says. These image shifts are laid to strain in the emulsion during processing. The second primary sources of random error are *setting error,* the inability of the comparator operator to repeat his measurements, and *identification error,* the inability of the operator to set the corresponding points of different images. Other random errors are "residual uncorrected environmental anamolies"—which might include anything from unusual grain patterns to tired blood to the effects of mass on light—and random errors of the measuring comparate.

In all, the art of data reduction practiced at the Atlantic Missile Range *routinely* is nothing short of amazing. Operating accuracies of about 35 sec. of an arc (that's ½ or 1/60 of 1/360 of a circle) are obtained with the cinetheodolites, and 2 sec. of an arc with the ballistic camera are common at the range. That's cutting it close, but plans call for even thinner slices.—THE END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RANGE PHOTOGRAPHY

(*continued from page 37*)

Another variation on the Graphic shutter is a rig enabling four, eight or twelve cameras to be tripped by remote control solenoid on the back shutter. Remote control was always possible using the front shutter synchronization but the top speed of 1/200 was not enough.

These cameras are used for sequential pictures, being fired from the blockhouse by visual control. The efficacy of this method was shown recently when a missile took off in such a hurry that automatic framing cameras missed it. In the time needed to change frames, the missile was out of sight. However, visually-controlled Graphics were able to get pictures.

The nearest that a cameraman can approach a missile during firing is 2800 ft., so that a long focal length lens is a must if a good-sized image is to be had. However, most long focus lenses equipped with between-the-lens shutters have a limited top speed because of the large-sized shutter required. At the Cape, some of the still photographers hit upon the idea of using a behind-the-lens shutter with a long focus lens. The rear element is usually smaller than the front element permitting a smaller shutter to be used. This arrangement combines the advantages of a long focus lens with the high speed of a small shutter. The combination was designed for use with Deardorff View cameras which are used for many of the pictorial shots.

Bob Special, one of the still men and a 35mm advocate, developed an adapter for using very long focal length lenses with his Nikon Reflex. The gadget was dreamed up by the photographers and made by the well-stocked repair shop in Photo Facilities.

Remote control firing of cameras is almost a science here where most pictures are made from dangerously close distances. The remote switches come in a variety of forms and sizes, from the elaborate timing boxes and control panels, to the manually-operated trip switch. They have even rigged switches on missiles so that the bird can take its own picture upon takeoff. A time delay is hooked into the line so that the camera can photograph a predetermined phase of the launch. The 8 x 10 Deardorff is used often for this type of work.

About half the stills at the Cape are in color, mostly 4 x 5 sheet film, Type S Ektachrome. Black-and-

white emulsions range from Polaroid to Tri-X and Super Hypan.

Although an Air Force installation, the Cape is primarily a civilian operation as far as photography is concerned. The exception is a detachment of the 1365th Photo Squadron consisting of 12 enlisted Airmen and one civilian. Commanded by Captain Douglas Moynihan with Technical Sergeant Ben Tressy as NCOIC, the detachment operates only during Air Force missile tests, producing both documentary and tracking footage.

Equipment used includes 70mm Hulcher cameras mounted on a converted machine gun mount for tracking. There are four of these units, designed at Lookout Mountain for this purpose.

Documentary footage for the Air Force film report is shot with standard Eyemo cameras. The detachment generally covers two test launches a week, whereas civilian cameramen cover all operations at Canaveral for all services.

In retrospect, perhaps the most unusual aspect of photography at Cape Canaveral is that it is basically straightforward. The equipment, while all of top quality, is largely standard equipment used with surprisingly few modifications. Processing techniques and operating procedures are designed to produce consistently high-quality with as little temperament as possible. Yet in quality, achievement and scope, Cape Canaveral is most impressive. Photo coverage is organized with the precision of a military operation. There is a variety of equipment to choose from for maximum results. In fact, there is almost as much equipment as is needed to cover the most intensely-documented operation in history. There are no special designs or frills. What is the answer?

It is in the caliber of men who make up the Cape operating sections. For the most part, they are serious, hard-working and, in a certain sense, dedicated. This quality they would deny vehemently, but most of the people feel the importance of the work done and the need for constant improvement. There are the usual changes in method as new materials are developed. There are differences between cameramen and engineers on how things should be done. Basically, however, Cape Canaveral photographers are a group of professionals, doing a job that is important although not always pleasant. Most of all, they are doing the job well.—THE END

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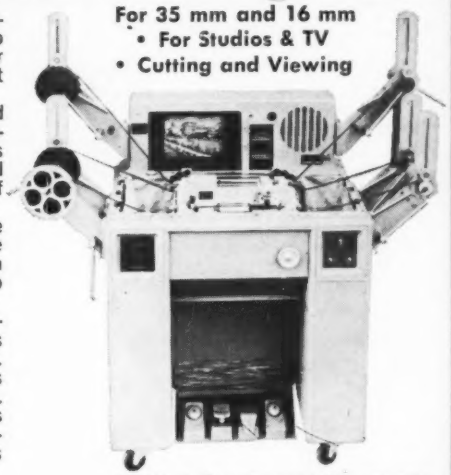

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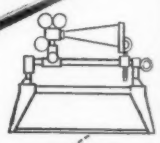

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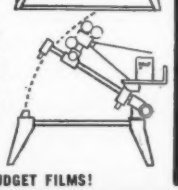

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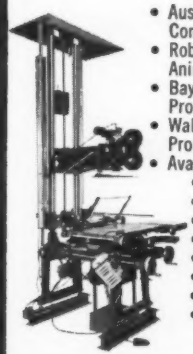

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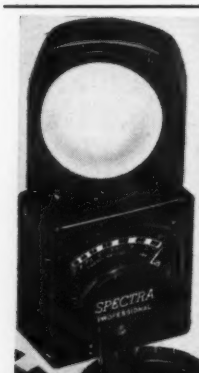

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METRIC OPTICS

(*continued from page* 39)

Optics coordinator, Mr. Starbird, working with the contractors. Although there may be more than one piece of equipment at a site, each piece supplies just one type of desired information.

Spatial data, the position of the missile at specific times during its flight, are supplied by Ribbon Frame cameras, CZR-1 and RC-5. This camera uses 5½-in. aerial film in 100-ft. rolls, placed in a drum. The film transport is stabilized at 30 in. per sec. Revolving about the film drum is the shutter drum, traveling at 1800 rpm. Six equally spaced slits in the shutter drum provide frame rates from 30, 60, 90 and 180 fps. The effect is that of a focal plane shutter, except that in this case, the number of slits, rather than the width of the single slit, determines the shutter speed. With one slit, the speed is 30 fps and the frame size is 1-in. high. With two slits, the speed is 60 fps and the frame size is only ½-in. At 90 fps, the frame size is ¼-in. and at 180 fps, it is ⅛-in. The frame width, of course, remains constant at 5½ in. Film used in this camera includes Super Hypan, Tri-X and Linagraph Shell Burst.

The ribbon frame cameras, perhaps the first cameras designed for missile work, were developed by Dr. Ira Bowen of the California Institute of Technology in 1942. Changes have been made in the original models, but the design remains the same.

These cameras are towed out to the selected test site and aligned to cover the proper area, usually from launch to 2000 ft. up. If two cameras are used so that the fields overlap, the field covered extends to 3500 ft. up. Once the camera is in position, test film is made and processed. If the lab report is positive, "shoot" film is placed in the camera and the orientation exposure made. This provides a reference for Metric Optics footage shot during the test phase.

Once all tests are completed, the camera is placed on operational standby for remote control operation. Set-up time per unit is about 1½ hours. It is estimated that test set-up time accounts for 35 per cent of the manhours of this section.

Lenses vary from 5-in. to 10-in. focal lengths, with apertures from f/4 to f/2.5, depending on the lens. Resolution under field conditions is listed at 20 lines per millimeter.

In addition to position, it is neces-

sary to determine the attitude of the missile in flight. This is done by angular measurements, measuring deviation from the projected trajectory. The raw data for this aspect is gathered by Askania Cine-Theodolites, a marriage of camera and surveyor's theodolite developed by the German Army before World War II for ballistics study. Askania is the Berlin firm which produces these instruments. However, several improvements have been made to increase the accuracy of the original, including finer engraving on the mount, improved control dials, smoother bearings and sharper lenses of increased focal length. These cameras are mounted in astrodomes and are operated by two men, one handling elevation, the other azimuth.

The theodolite consists of a camera on a U-shaped trunion housing. Two geared handwheels provide the vertical and horizontal movements (elevation and azimuth). These cameras use 35mm film in 100-ft. loads, exposing a standard 1 x 1½-in. double frame at 1, 2 or 4 fps. The lens has a 24-in. focal length working at f/4.5 and a resolving power of 30 lines/mm. A venetian-blind shutter with a speed of 1/150 sec. is used. These shutters are synchronized so that all cameras operate when the shutters are triggered by a pulse from the Master Theolodite Site.

A precision engraved glass circle is mounted on the elevation axis to measure this angle, while a second circle is mounted on the vertical axis to indicate azimuth. These glass circles are illuminated by strobe lamps triggered in synchronization with the camera shutter so that both circles and the target are recorded on the same frame.

Timing pulses are also shown on each frame for coordination with Range time. Timing code read-out is made at a rate of once per second. Thus, at one fps, every frame will show timing marks; at 2 fps, every other frame and at 4 fps, every fourth frame. The marks are based on 500 pps presence-absence code used at the Cape.

In addition to camera position as noted by the dials, and time as noted by the pulses along the frame edge, target boards are used for external orientation. These boards are photographed before and after each test with the camera in both normal and inverted position.

Cine-theodolite stations are manned at least three hours before test to permit necessary checking

(*continued on following page*)

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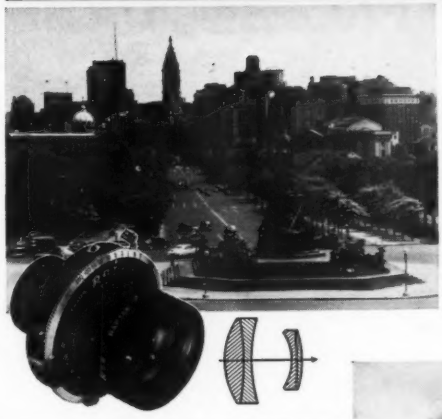

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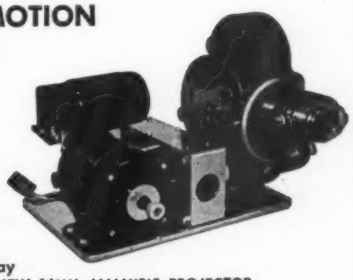

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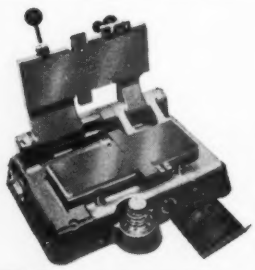

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METRIC OPTICS

(*continued from preceding page*)

and orientation. Test films are "slop" processed, this being quick processing to see if the camera operates properly. Another check is made after the operation.

The heavy artillery of Metric Optics are the tracking telescopes, IGOR and ROTI. These formidable names are not Norse gods but shorthand for Instrument Ground Optical Recording and Recording Optical Tracking Instrument. Both are long-range telescopes of observatory quality to provide data on events taking place beyond the reach of the basic cameras. Information covered includes stage ignition, exhaust configuration, structural integrity and flying characteristics. At present, there are three ROTI installations and six IGORs, four permanent installations and two mobile telescopes.

Photographically, both instruments are similar, using 70mm cameras to record the data. On IGOR, the camera is a Flight Research Model V, taking 2¼ x 2¼-in. pictures on a 1000-ft. roll of film. The frame rate ranges from 10 to 60 fps. The shutter is an adjustable rotating shutter, from 0 to 120 degrees. If desired, a 35mm Mitchell Hi-Speed camera can be used, making single-frame (1 x ¾-in.) exposures from 8 to 96 fps. Both cameras provide for time coded, engineering sequential and documentary coverage.

Engineering sequential and documentary coverage is, in a sense, a by-product of data recording. This coverage represents a complete record of all events occurring during a test flight, from launch to stage separation, burn-out, etc.

The camera on ROTI is a Photo-Sonics Model 10A. Frame rates and format are similar, as is maximum film load and shutter design, to the IGOR camera. Both cameras have projected fiducial marks.

Both systems also use automatic exposure control for even illumination despite varying sky background. Light conditions are measured continuously and compared with a reference light source within the instrument. The difference in light intensities between the sensor, which picks up outside illumination, and the reference light, produces an error signal which is fed into a servo unit. This unit drives a pair of variable density filters located in the light path of the optical system which can maintain illumination range at the film plane

to within ¼-stop accuracy.

In addition, both instruments have tracking radar for automatic focusing, using a focusing lens on IGOR and a pair of focusing wedges on ROTI.

Another member of the tracking telescope system is the Boston University Telescope, a manually-operated instrument with a fixed 240-in. focal length. This is in contrast to IGOR and ROTI with focal lengths which vary from 100 to 500 in. Photographic recording is by means of a 35mm Mitchell mounted at the focus point of the 240-in. lens system. A 90-degree beam splitter permits simultaneous viewing with two cameras if desired, one camera viewing directly through the beam-splitter. The Boston University Telescope is a comparatively simple system which can be airlifted to any desired location.

The last of the Metric Optics instruments is the Sandia Tracking Telescope with two fixed systems, one 105-in. focal length, the other, 180-in. focal length. Photo recording is by means of 35mm Mitchells of a slightly different design than those used with the Boston Telescope. The Sandia telescope is not portable, being mounted in an IGOR astrodome.

The current practical limit of photo recording lenses is a 500-in. focal length. An attempt was made to get a 1000-in. lenses but there was a marked loss of contrast, poorer definition and mechanical difficulties as far as lens design and construction were concerned.

It is quite possible that in the future, a method of using electronic sensors with cameras rather than photographic film will be evolved. The dimensional instability of photographic emulsions causes a loss of definition which can be critical at extremely long ranges.

The development of such electronic sensors would make on-site processing and reading feasible, reducing the time lag in getting data to the missile contractor. Some of the data, such as that collected by Theodolites, can be put into digital form and taped for use in computers. Other data, such as that observed by IGOR and ROTI, might be scanned by photoelectric cells adjusted to reproduce the tones of the standard H & D curve, giving the speed of television with the image quality of photography. It appears that the demands of the missile age are forcing traditional rivals, photography and electronics, into a marriage of convenience.—

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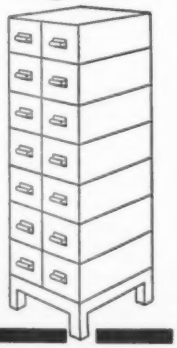

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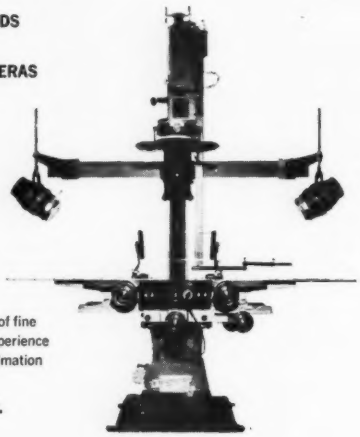

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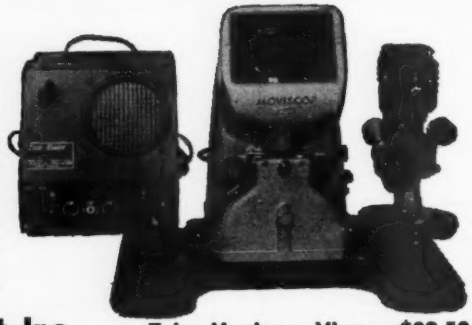

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BALLISTIC CAMERA

(*continued from page 55*)

image throughout their focal plane is tested to within 1/1000mm or better.

While neat, the cameras are not dainty. Packed for the road, they weigh from 641 to 693 lbs., depending upon which lens is being used.

Actually, photography is the least of the problems in operating one of these units. Exposure is quite simple because most of the time the camera is used wide open. The images are, for practical purposes, infinitely distant points of light, usually quite faint.

In some instances, Glei explains, a missile test depends on whether or not ballistic camera data can be obtained. Only one plate can be exposed per camera. If there are clouds in the sky, or if the moon is in the vicinity of the estimated trajectory—the decision to fire may depend on the judgment of a crew of two camera operators on an island in the Atlantic hundreds of miles from nowhere.

Glei, therefore, takes no pains to find a person with photographic experience when adding to his staff. Instead he looks for a man who can learn the relatively minor photographic aspects of the job, master the electronic complications, pay attention to the tedious but necessary technical detail, learn to be a shrewd practical meteorologist, pick up some astronomy and keep cool and alert.

The astronomy comes in from lining up the camera with the North Star to the final reduction of the data. One of the principles on which the accuracy of the ballistic camera data rests is this fact: given a specified viewpoint from the earth, if a missile's position is known in relation to three stars then its elevation and azimuth can be determined from long-since published astronomical data. Furthermore, since both the stars and the missile are equally affected by the light-bending ability of the atmosphere, these measurements are almost as good as if they were made in a total vacuum. Thus even the daytime shoots are calibrated by photographing a star background before and after the main exposure. The camera crew must be familiar with the stars, their magnitude and motions and when to shoot them in order to furnish adequate reference points.

Time is just as important a part of the information as direction and

distance, and the operators must be adept at using the time measuring devices. The most important of these is a 1000-cycle per. sec. signal generated at the Cape—or with independent signal generators on outlying stations which are synchronized with this master signal. This can be used to operate the camera shutter at any specified 1/1000 sec. point in time (signal delay through the cables is calculated on the basis of distance). A chronograph is used to record the time of the star calibration. Another device is a photocell which indicates what time a flare or stroboscopic light on the missile goes off.

These flares and strobe lights are used to indicate the trajectory of the missile after burnout. Strobe light is superior because it is briefer, but its range is only 250 to 300 nautical miles. The flares, 1 oz. "Daisy" pyrotechnic flares, can be recorded at distances in excess of 5,000 nautical miles.

The star calibration calls for a special technique which has a two-fold purpose: to furnish a point of light rather than a line for measuring, and to positively identify which point belongs to which star trail. This is done by following this sequence in exposing the night sky: shutter open 2 sec., shutter closed 30 sec., shutter open 1 sec., closed 30, open ½, closed 30, open ¼. Then the shutter is opened for the trajectory shot, or opened repeatedly for daytime shots (flame chopping). Finally the star calibration is repeated in reverse order. The pattern of the star calibration is: — – – . . – – —.

As the Atlantic Missile Range screwed down the accuracy of missile tracking with the introduction of these cameras in 1956, a discrepancy was noticed in the trajectory indicated by cameras at some sites relative to data from other sites. The discrepancy was due not to the ballistic camera system, but rather to inaccuracies in the survey which located the camera sites. They were relocated on the charts. On one of the missile tests it was decided to position a camera on the island of Bermuda to find out where it was in terms of the North American continent. Figuring backwards from the plotting of the missile trajectory, the island was located to an accuracy of 8, 21 and 10 ft. in a rectangular coordinate system, moving it significantly without the natives knowing a thing until they read the news some time later.—THE END

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PMI'S DIRECTORY OF INDUSTRIAL DEALERS

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Encino—TRiangle 3-3373
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Birns & Sawyer
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Hollywood—HO 4-5166
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Bob Gambles Photo Supply
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Los Angeles—HO 4-1148
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Standard Camera Supply
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Los Angeles—WE 6-8281
Industrial—Graphic Arts—Verifax Supplies

The Harwood Co.
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Sacramento—V 3-2859
Photographic Suppliers to Industry

Brooks Cameras, Inc.
45 Kearny at Maiden Lane
San Francisco — EX 2-1902
"The Photographic Dept. Store"

Foremans
Industrial Photo Div.
121 E. 4th Avenue
San Mateo—Diamond 3-5300
Sales & Rentals; Photo Instrumentation; Verifax; A-V

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Miami—PL 4-2578
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Chicago—ANdover 3-0749
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Standard Photo Supply Co.
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Chicago—SUperior 7-3124
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Watland, Inc.
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Chicago—PRospect 8-4400
A—V—Industrial—Verifax—Graphic Arts—Microfilming

Oak Park Camera Co.
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Oak Park—Euclid 6-6447
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Klein's Photo Center
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Waukegan—ON 2-4530
Equipment — Supplies — Sales — Rentals

INDIANA

Hoosier Photo Supplies, Inc.
1210 No. Pennsylvania
Indianapolis—ME 8-3492
Industrial — Graphic Arts — Verifax — Retail

KANSAS

Bob Gaskin's Industrial Photo Sales
631 E. Harry
Wichita—FO 3-4746

MASSACHUSETTS

Industrial Photo Prods., Inc.
257 Franklin St.
Boston—LIberty 2-9655
Cronaflex—Engineering—Office Copying—Graphic Arts

MISSOURI

W. Schiller & Co.
1101 Clark Ave.
St. Louis—CH 1-7020
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NEW JERSEY

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287 Washington St.
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Schaffer Camera Co.
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NEW YORK

Stickley-Siver, Inc.
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Binghamton—RA 4-4336
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Aims Photo Equip. & Supply
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Brooklyn—Ulster 2-7300
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Unicam Camera Exchange
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New York—YUkon 6-4538
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- INDUSTRIAL TRIPODS & HEADS
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Get more information. Circle 491, page 77

(*continued from page* 49)

sheet is processed. The sense strip is appropriately labeled and sent to the chemical control lab where its densities are measured and plotted. If it shows a processing variation beyond control limits set by the Standards Department, the contributing factor is located and corrected.

When Standards first instituted this program, they found seemingly inexplicable variations. Close investigation revealed that the gaseous burst agitation system was at fault. The volume of nitrogen released with each burst was consistent enough, but the pattern of gas release was *in*consistent enough to cause processing variations particularly noticeable in normal to hard negatives. It turned out that the gas burst solenoid valve would sometimes shoot its wad at the beginning of the burst. At other times it would give a hesitant release of nitrogen which would slowly build to a climax. In either case the *amount* of gas released did not vary, but the *effect* on the film did, disturbingly so.

Standards located a new solenoid valve, and cranked up the gas pressure to near maximum, (15 lbs. per sq. in.) so that only one pressure variable (low pressure) would have to be watched.

It sounds complicated, but the elimination of variables in negative processing has paid off in simplifying the work of printing the pictures, as the printers testify.

This sort of scientific-minded trouble shooting often falls to the Standards Group. A recent piece of detective work turned up something never before recorded about graininess. Standards was investigating appropriate filters for black-and-white work to cut down the brilliance of the Florida sky. Specialist D. A. Odell found that some of the photographers on the range would leave a color conversion filter on their cameras when switching from color to black-and-white, with the idea of cutting down blue sensitivity. Odell made a comparison test, shooting one picture without a filter and one with the conversion filter. Results from the latter made it look like an entirely different film, it was grainy as a pebble beach. Conferences with the film manufacturer evoked surprise, and a tentative explanation: the small crystals of silver halide in the film were getting little or

(*continued on page* 76)

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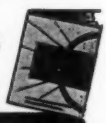

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AUDIO-VISUAL

FILMSTRIP CONTAINERS 203
FilmKare Products Co. Illustrated specification sheet describes FilmKare's lightweight filmstrip containers in color. Includes prices. Free samples are available.

DIRECT WIRE TV 204
Argus Cameras, Inc. 16-page booklet tells how to use direct wire TV as a tool for business and industry.

TECHNAMATION 205
Technical Animations, Inc. 12-page booklet describes the Technamation process of motion without movement.

SLIDE PREPARATION 206
Projection Optics Co., Inc. 12-page booklet, *Vis-Ability Unlimited,* describes materials and methods for the preparation of transparent slides for overhead projection.

TAPE REPEATER 207
Cousino Electronics Corp. Illustrated catalog sheet describes the Mag-Matic self-threading tape repeater for single track record-playback operation. Inculdes applications and specifications. Also gives prices.

MAGNETIC RECORDERS 201
Amplifier Corp. of America. Booklet illustrates a new series of ultra-compact Magnematic Bookshelf recorders. Includes complete specifications and prices for 20 different models. Optional features and accessories are also listed.

PROJECTION SYSTEM 202
TelePrompter Corp. Illustrated catalog sheet describes the TelePro 6000 front and rear screen projection system. Lists features and complete specifications.

CAMERA & LENS

PRECISION OPTICS 214
Plummer & Kershaw. Brochure describes precision optics, both custom made and mass produced.

BALLISTIC CAMERA 215
Wild Heerbrugg. 8-page illustrated brochure describes the Wild BC-4 Ballistic Camera. Includes complete technical specifications.

INTERCHANGEABLE VIEW CAMERA 216
Karl Heitz, Inc. 24-page booklet illustrated in color gives applications of the Sinar Interchangeable View Camera.

BOOKLET ON LENSES 208
Exakta Camera Co. 8-page booklet, *Use the Right Lens to get the Best Picture Every Time,* explains the functions of different lenses and shows how each should be used to the best advantage.

MOTION ANALYSIS CAMERA 209
Missei Sangyo Co., Ltd. 4-page illustrated brochure describes the Hitachi High-Speed Motion Analysis Camera Type 16H. Includes complete specifications and list of accessories.

AUTOMATIC ROBOT STAR 210
Karl Heitz, Inc. Color booklet describes the Automatic Robot Star cameras. Includes information on special industrial models and camera holder for photographic recording.

MISSILE TRACKING CAMERA 211
Flight Research Inc. 4-page illustrated brochure describes the Multidata Model V 70mm missile tracking camera. Lists features.

FILM HOLDERS 212
Hoffman Professional Camera Co. Catalog sheet describes Professional cut film holders available from this company and outlines repair services available.

PLASTIC LENSES 213
Fostoria Corp. 4-page bulletin discusses advantages, applications, specifications and manufacturing facilities for light weight, optically ground and polished solid plastic lenses.

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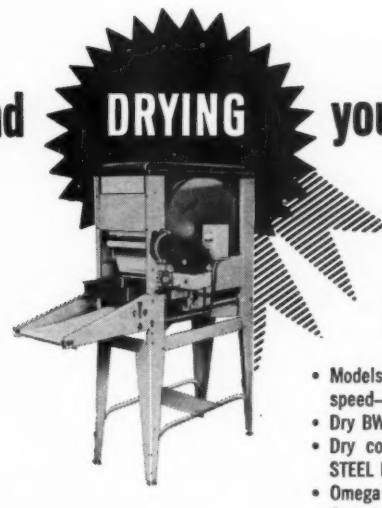

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EDMUND CATALOG 217
Edmund Scientific Co. 144-page illustrated catalog lists equipment for science, math and optics available from this company.

STEREOCOMPARATOR 218
Wild Heerbrugg. 4-page illustrated leaflet describes in detail the Wild STK-1 Stereocomparator for increasing economy of photogrammetric single-point measurement Includes list of applications and information on construction.

ACCESSORIES PRICE LIST 219
Abbe Films & Equipment Co. Price list for projection lenses, ring adapters, film leaders, reels and cans, shipping cases, projection lamps and exciter lamps.

EQUIPMENT

REFLECTAL 220
Photo Lectronic Research. Illustrated brochure describes the Reflectal for soft, diffused illumination of indirect lighting with complete control and direct light efficiency. Lists accessories available.

PRACTICAL AUTOMATION 221
Automatic Timing & Controls, Inc. Catalog sheet describes the application of automatic control instruments to industrial machine and process operations.

QUICK REFERENCE CATALOG 222
Benson-Lehner Corp. 8-page illustrated catalog lists record readers, plotters, machine language translators and photo instruments available.

PYROMETERS 223
Servo Corp. of America. Technical bulletin describes Servotherm(R) industrial infrared radiation pyrometers. Includes specifications and lists accessories.

PHOTOGRAPHIC CATALOG 224
Interstate Photo Supply Corp. New 1960-61 catalog describes all the photographic lines exclusively represented in the U.S. by Interstate Photo Supply Corp. Includes cross index for easy reference.

SCOPUS CATALOG 225
Scopus, Inc. New Scopus catalog gives complete information on the group of photographic lines handled by this distributor. Includes specifications and pertinent data.

LAMPS FOR HIGH-SPEED 226
Westinghouse Electric Corp. 3-hole punched loose-leaf sheet describes the new Westinghouse 300-watt reflector lamps for high-speed photography. Includes exposure data and technical data.

PROCESSING EQUIPMENT 227
Kelvin & Hughes America Corp. 4-page illustrated leaflet gives data on continuous film processors, Type RP1 and step-by-step film processors, Type RP3. Includes specifications.

KENYON STABILIZER 228
Kenyon Products, Inc. Specification sheet describes the Model KS-4 Kenyon stabilizer. Includes mechanical and electrical characteristics.

ASCORLUX CATALOG 230
American Speedlight Corp. 8-page catalog covers the complete line of Ascorlux xenon arc equipment. Contains complete technical specifications on the lamps, power supplies and accessories.

PORTABLE DARKROOM 231
Cormac Chemical Corp. 8-page reprint, *Unibath, U Bet,* provides a long and explicit analysis of the use of the Unikit Portable Darkroom at the 1960 Kentucky Derby.

CAMERA DRIVE MOTORS 248
Camera Equipment Co., Inc. 3-hole punched loose-leaf sheet describes six CECO camera drive motors. Includes specifications. Also gives data on the Programming Device Model 640A.

GRAPHIC ARTS

GRAPHIC BOOKLET 232
The Gevaert Co. of America, Inc. 12-page booklet, *Graphic Films,* describes Gevaert films for line and halftone photography and for continuous tone reproductions. Includes section on separation panchromatic films.

PHOTOCOPYING METHODS 233
Anken Chemical & Film Corp.. Pamphlet describes special photocopying techniques. Deals with special papers, film positives, Monobath solutions and other materials and methods designed to help the industrial and commercial photographer.

PRICE LIST 234
Miller-Trojan Co., Inc. 30-page illustrated schedule gives prices and specifications for equipment available from this firm.

BROWN CAMERAS 235
W. A. Brown Mfg. Co. 4-page illustrated brochure describes the Commodore series of Brown cameras. Includes specifications and space requirements.

FILMSORT COPIER 236
Minnesota Mining & Mfg. Co. Illustrated catalog sheet describes the Filmsort "Uniprinter 085" copier. Includes specifications.

READER-FILLER 237
NB Jackets Corp. Illustrated specification sheet describes the NB Reader-Filler which lets you view the film as you automatically file it into notched jackets.

PARA-TIPE ALPHABETS 238
Para-Tone, Inc. 32-page catalog gives listing of type faces available and illustrates each one. Includes instructions on use.

SPECIALIZED LUBRICANTS 246
Anchor Chemical Co., Inc. Illustrated catalog sheet describes Anchor's specialized lubricants designed for graphic arts equipment. Includes packing and price information.

DIAZO PHOTO PROCESS 239
Andrews Paper & Chemical Co., Inc. 6-page folder describes the diazo photo process, diazo photobase paper and diazo photo originals. Includes sample dry diazo photo print on Baryta coated base paper.

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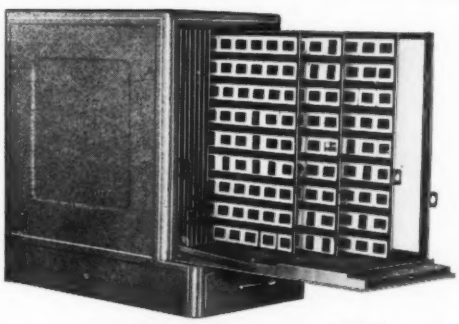
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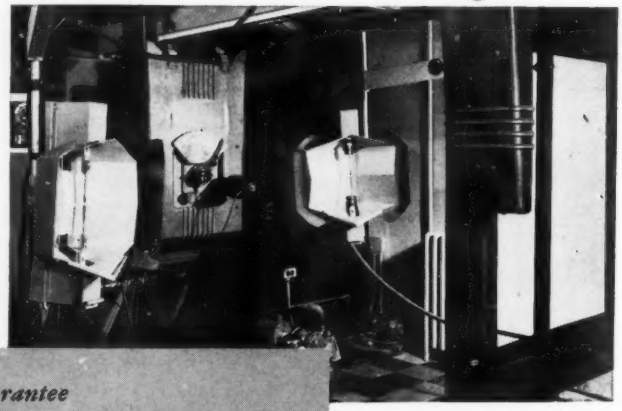

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(*continued from page 72*)

no exposure, while the big crystals were responding nicely to the light passing through the filter. Photographers on the Cape were so advised.

One area that is getting the closest scrutiny from Starbird and his staff is the matter of photographic sharpness. Standards presently uses three means to measure this aspect of photographic film. One is resolution. A special piece of equipment, a Swiss-built resolvometer, exposes an extremely fine grid of lines on test films. Results are read with a microscope. A second method is acutance. A knife blade was built into the sensitometer for measuring image spread. A recording microdensitometer now attached to another department is used to indicate the film's response to this test. A third method is to photograph resolution targets containing the colors commonly encountered on the range when photographing missiles. This, of course, measures not only the resolution of the film but also the resolution of the lens, and still does not avoid all the pitfalls of resolution tests. Starbird has a strong suspicion that the answer for his purposes lies in a recent offshoot of the recent information theory, namely sine wave analysis. In this, a series of closely spaced dots or lines is exposed on the film; the photographic image of these lines or dots shows not a sharp cut off between the lines or dots but rather hills and valleys—hills at the point of great exposure and valleys at the point of least exposure. The curve outlining these hills and valleys is in the shape of a sine wave and it is a function of the image spread. The shape of this curve can be described mathematically. Starbird believes that this idea can result in a concise description of a film's ability to give maximum information about the behavior of a missile. He's hot in its pursuit, on the theory that fewer guesses and more facts will result in better photography.—THE END

NEXT MONTH

Regular columns by Arnold Eagle, Lloyd Varden and William Hyzer, as well as the PMI Index for 1960, will appear in the January issue of PMI.

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NEW PRODUCTS

For additional information on any new product circle the appropriate number on the readers' service card, page 77.

VITO CLR **112**
A new 35mm Voigtlander camera, the Vito CLR, with built-in coupled exposure meter and rangefinder, has been announced by H. A. Bohm & Co. Featuring an f/2.8 Lanthar lens, the Vito CLR automatically sets correct exposure when two exposure meter pointers on the camera top are aligned. Shutter is the Prontor LK with speeds from 1/15 to 1/500 sec. plus B and self-timer. Price: $89.50.

EXPOSURE METER **113**
The Realt "Ile de France" is an automatic exposure meter which gives direct readings of lens stops, shutter speeds or exposure values without any settings, calculations or back checking. It reacts to less than 0.2 foot candles, and has a directional grid that allows passage of light corresponding to the field covered by the camera lens. A system of 10 interchangeable film-speed charts adapts the Realt to any new ASA ratings. Price: $29.95.

PLASTIC FRAME HOLDER **114**
A heat-resistant plastic frame holder which permits easy handling of 35mm transparencies is the Agfacolor Slide Frame. Price: box of 20 frames: $1.85.

WIDE-ANGLE LENS **110**
The Auto-Takumar f/3.5 five-element wide-angle lens, which provides a 63-degree angle of view and weighs 5.2 oz. in leather case, has been introduced by Minneapolis-Honeywell's Heiland Div. It is equipped with a diaphragm-cocking lever and will stop down automatically when the shutter is released. Price: $84.50.

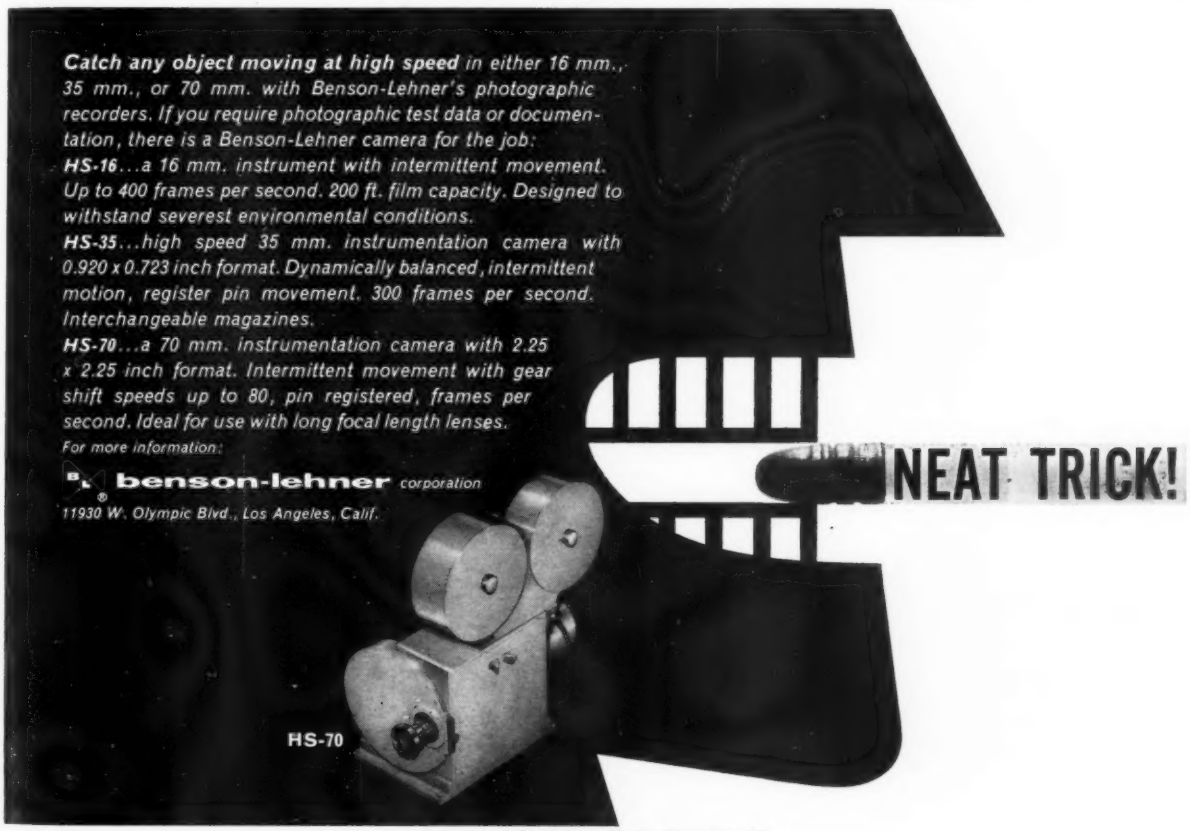
SLIDE PROJECTOR **111**
A fully automatic 35mm slide projector, the Balomatic 655, has been announced by Bausch & Lomb, Inc. It features remote forward/reverse operation, single slide operation and editing. Slide changing is accomplished by one-button control that operates at the projector or as far as 15 ft. away with remote control cord. Slides may be shown singly, loaded into a tray while projecting or repositioned for proper screen orientation. A timer allows automatic operation with intervals continuously variable from 4 to 30 sec. Price, including 5-in. f/3.5 projection lens: $119.50.

FILM PROCESSOR **103**
An automatic Rapid Spray Film Processor which handles 16mm or 35mm black-and-white positive motion picture film at speeds up to 150 fpm has been introduced by Houston Fearless. The unit can process negative film up to 100 fpm. Complete processing time for positive film is as short as five minutes from dry to dry, it is claimed. High impingement spray application of the developing solution, fix and wash, utilizing spray bars, makes this processing speed possible, according to the manufacturer.

OZALID DIAZO FILM **104**
A new Continuous Tone Film, called 111CTF, has been developed by the Ozalid Div. of General Aniline and Film Corp. It is a diazo film designed specifically to compete in making duplicates of continuous tone negatives or continuous tone positives.

MAGENTA CONTACT SCREEN
The Kodak Magenta Contact Screen for Photogravure has been announced by Eastman Kodak Co. Intended primarily for the color field, it provides a method of producing hard dot screen positives for gravure printing. Kodak Magenta Contact Screens are provided in one screen angle and are obtainable in various sizes ranging from 8 x 10 in to 29 x 29 in.

MAGNETIC-TAPE CLIP **121**
A plastic clip that slips between the flanges of reels to hold loose ends of magnetic tape in place has been developed by Minnesota Mining and Manufacturing Co. Called the "Scotch" brand Tape Clip, it is being merchandised in packages of 10 at a retail price of 35¢.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EXA MODEL II 115

The Exa Model II 35mm single-lens reflex camera, with lenses and accessories interchangeable with the Exakta, has been produced by the Exakta Camera Co. It has a focal-plane 9-speed shutter with speeds from ½ to 1/250 sec. and is internally wired for flash and electronic strobe. Other features are: single shutter speed setting dial; film-type indicator; automatic film counter; and Exakta bayonet lens mount. Prices: with f/2.8 Isco Westanar lens—$99.50; with f/2.8 Zeiss Tessar—$119.50.

16MM PROJECTOR 116

The P16-S105 Weinberg-Watson 16mm Analyst Projector, which offers "flickerless projection regardless of the frame rate," has been announced by the Camera Equipment Co. It has variable speeds from 2 to 24 fps in both forward and reverse, and an electrically operated single frame advance. The projector can be operated from a remote control box which is furnished with an indicator lamp for identifying controls in the dark. It is equipped with a 2-in. f/1.6 lens and a 750W lamp; and accepts 400-ft. reels.

TARGET FINDER 117

An Auxiliary Target Finder for Arriflex cameras has been made available by the Arriflex Corp. of America. The instrument is designed to show the photographer a clear reticle projected in space out over a wide field. When the center dot of the reticle is superimposed on the target, the object is automatically centered in the frame of the camera. Price: $80.

LIGHT SENSING UNIT 118

The Hycon Mfg. Co. has completed its first article Photocell and Amplifier Unit for use on Lockheed's P3V-1 aircraft's camera system. Used during night photography, it "sees" the light from an exploded photoflash cartridge and subsequently commands the camera system to go into operation. The unit is fully transistorized and all components are mounted in an aluminum case which is completely sealed with an epoxy potting compound. According to the manufacturer, it may become standard equipment on a large number of aerial photography vehicles.

PORTABLE COUNTER 119

A new Model 1301P Portable Counter for making precise time measurements has been announced by Aerotronic Associates, Inc. With accessory equipment it can be adapted to measure shutter speeds, synchronization, movie camera speeds, etc. It measures in the audio range from 1 cps to 20 kc. Price: $375.

TESTING PRESSES 107

Two new models of Engler Gravure and Aniline Testing Presses for in-plant laboratory testing of flexographic and rotogravure inks, papers and coatings have been produced by Amsterdam Continental Types & Graphic Equipment, Inc. Model FTM 130 is available in paper widths of 6 x 12 in. and can be equipped for testing either gravure or flexographic inks. Model AFTM 149 takes a 6-in. paper width and includes a built-in adapter for testing of both gravure and flexographic inks, as needed.

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ENLARGER ACCESSORIES
A new Kodak Filter Adapter is one of the accessories introduced by Eastman Kodak Co. for its Auto-Focus Enlarger 5 x 7. It permits the use of color printing (CP) or Polycontrast Acetate Filters between the light source and the negative, therefore having no affect on the optical image. Price: $150.

A Film Negative Carrier for the Elipton Color Enlarger 4 x 5 has been designed to permit handling 90mm, 70mm and 35mm roll film. Price: $310. A Film Negative Carrier Adapter permits this carrier to be used on the 5 x 7. Price: $200.

REVOLUTE COMET **109**
The Revolute Comet, a diazotype reproduction machine designed for high-quality work on a production basis is now being produced by Paragon-Revolute Div. of Charles Bruning Co. The unit offers a machine speed of 75 fpm or 125 fpm as optional, and is available in either 54-in. or 42-in. printing widths. According to the company, an air knife-suction separator provides automatic separation, even at high speeds.

PROJECTION B EMULSION **106**
Peerless Projection B Emulsion, a slow-speed projection emulsion designed for microfilm enlargements, template reproduction, and similar applications is now available on a larger variety of base stocks, according to an announcement from Peerless Photo Products, Inc. In addition to the present cloth and vellum bases, the emulsion is now being coated on both 55 gram .003 100 per cent rag stock and on 85 gram .004 alpha sulfite paper. It has a sensitivity level that permits it to be safely handled under Series OA yellow safelights and provides fine image-resolution and a contrast which will produce good results under a wide range of exposure conditions, it is claimed. The two new base stocks are available in 10 standard sizes, from 8½ x 11 to 30 x 42.

SLIDE MOUNTS AND BOXES **120**
A new nest-type cardboard slide mount for 35mm double frame transparencies and a flip-top box that holds 24 2 x 2 slides have been produced by the Seary-Michelbach Corp.

SPLICING TAPE **123**
Two new sizes of Mylar splicing tape have been announced by Robins Industries Corp. Model No. ST-234 is ¼ x 100 in. and lists for 40¢. Model No. ST-750 is ¾ x 100 in. and lists for 60¢.

MINIATURE TAPE RECORDER **124**
A fully-transistorized miniature portable tape recorder measuring 4¾ x 2½ x 8 in. and weighing 3½ lbs. has been announced by Universal International Sales Corp. Operated on regular pen light batteries, it records up to 32 min. Price: $97.50.

POLA-SCREEN & VIEWER
The Kodak Pola-Screen and viewer are now available as one unit, packaged in a plastic case. According to the company, the price of the new combination is less than that of the two items purchased separately.

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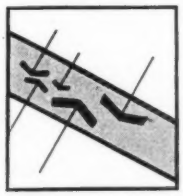

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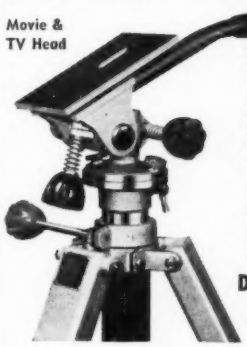

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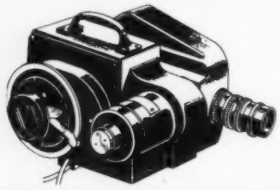

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WORKING PHOTOGRAPHER

(*continued from page 21*)

the bare photo-cell right at the light source: either an incident light meter without diffusion sphere, or a reflected light meter used without diffusion disk as an incident light meter. Each type and individual meter varies a little here, but the factor runs about 8 to 10 times meaning that you give that much more exposure than the meter used in this unorthodox way indicates.

Now we get back to some basics on meters. Meters can be made more sensitive by putting on a longer, more sensitive scale; but this affects portability. Weston and GE in effect do this by changing scale readings and sensitivities with baffles. But a very sensitive and accurate needle on a long scale would not be rugged, portable, practical for on-location photography. Best solution for meters of this type would be a cell in which the very weak current of a low light level impulse on the cell would be amplified by, say, transistors and batteries. One American manufacturer has had a prototype of this sort around, but not yet on the market. So that's why I'm pleased to hear of a meter with a cadmium sulfide cell and using a small mercury cell battery and transistors in an amplifying circuit. Shown at the Photokina, the Lunasix is reported sensitive enough to read a moonlit landscape, small enough to be portable, and rugged enough to serve an industrial photographer. I await its introduction to the American scene with great interest.

Also to appear soon is a meter by Asahi, something like the Elwood Foto-meter incorporating brightness readings from a small spot in the field. They are also building such a meter into a camera finder so the knowledgeable photographer can take readings from the part of the subject he wants read regardless of the acceptance angle of lens or meter. Right in this line, Kilfitt, who makes the fine long focus lenses has come along with a meter that fits into the filter slot behind each lens so that the exposure reading is read of the exact acceptance angle of the lens being used. An interesting side-line to this is that the meter can be set for a shutter-film speed combination and the lens is then stopped down until the meter indicates a correct setting. This would be especially handy for extreme close-up work, it seems to me, if extensions could be accounted for here, too.—THE END

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(*continued from page 24*)

compact inexpensive rotary portable microfilm cameras in connection with commercial processing services that are everywhere available, the point where microfilming becomes financially possible is surprisingly low. Checks which have been bank stamped and endorsed are not negotiable but if they are lost the problem of securing payment from the originator can be difficult. From microfilm, a paper facsimile can easily be produced by continuous machine methods and with it there is usually little difficulty in securing a replacement check or other payment. At need, legal proceedings could be instituted with every chance of success. In the case of payroll checks the customary indemnity bonds for replacement checks have often been waived where microfilm copies have been made.

Incidentally, it is well known that stringent regulations of the United States Treasury prohibit the photographic reproduction of money including currency and certain other Federal documents; penalties for violation are severe. It is not generally known that under certain circumstances and restrictions money may be microfilmed. According to the Recordak Corp., a U.S. Treasury Department regulation issued in 1946 gives *banks* permission to microfilm currency "provided that the microfilm records are maintained as confidential." The value of preserving serial numbers is obvious.

There are numerous evidences of obligation which are not bank checks. The department store or other charge account with its basis in a sales slip or similar record is an example. A charge sales slip can be handled in very much the same way as a bank check and the record keeping procedures can be simplified all along the line through the use of microfilm. Microfilm copies of sales slips simplify billing and mailing. Original sales slips returned to the customer with his bill, just as cancelled checks are returned with a bank statement, present a complete record and facilitate collection.

Microfilm reproduction is a tool, perhaps even a full kit of tools, whose application is limited only by the initiative and imagination of the microfilm entrepreneur who might well ponder the answer given by a world-famous artist to a query voiced by an admirer, "With what do you mix your paints?" The answer came quickly and to the point, "With brains!"—THE END

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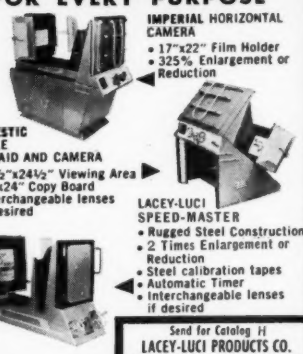

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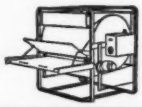

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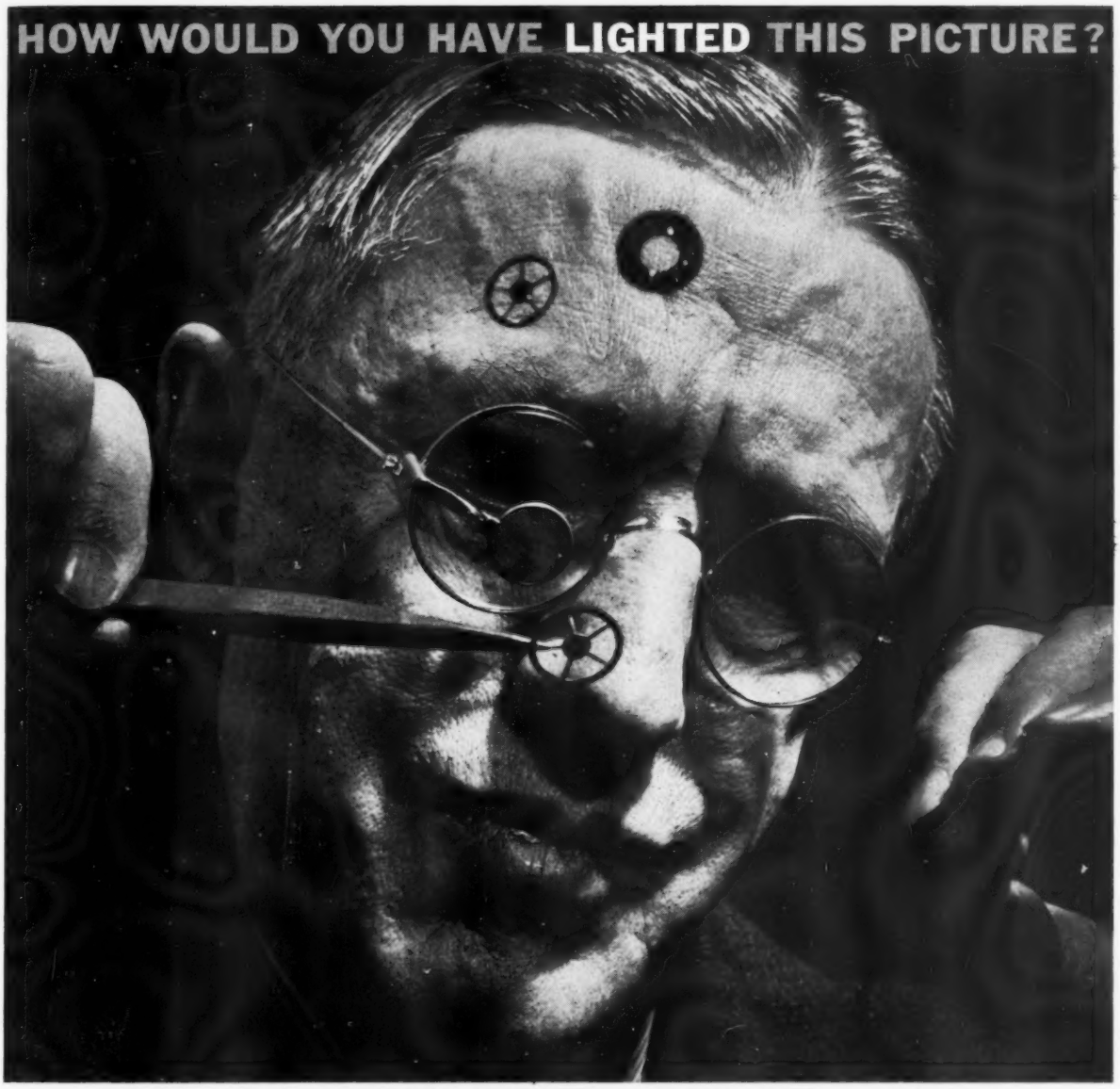

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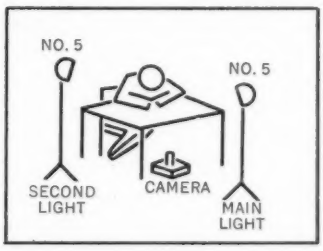

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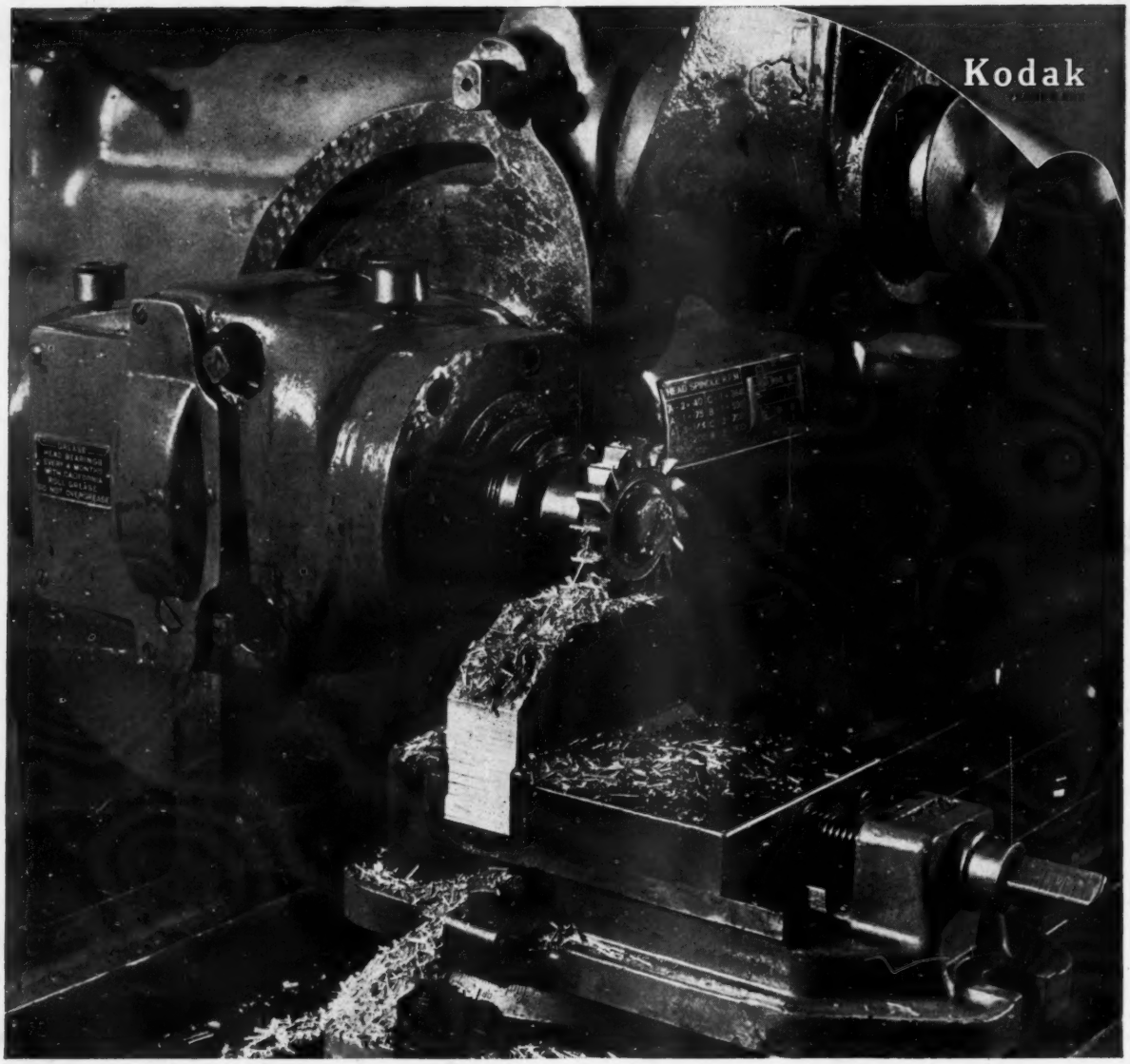

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